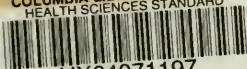


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THE
Principles and Practice
of Tooth Extraction
and
Local Anesthesia of the Maxillae

By
WILLIAM J. LEDERER, D.D.S.
Dental Consultant to the German Hospital in the
City of New York

Illustrated with 120 Textual Figures and 8
Figures on 4 Plates



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This little volume
is dedicated to
my Father
Mr. Emanuel Lederer

AUTHOR'S NOTE

IN OFFERING this little volume the author does not presume to have fully exhausted his subjects; he presents these in compend form, to aid both the Dental Student and Practitioner and recall to their minds that Teeth Extraction is a Surgical Procedure and must be carried out accordingly.

The chapters on CONDUCTIVE ANESTHESIA should emphasize the great value of this method in performing painless operations about the teeth and jaws. PAINLESS DENTISTRY is not a dream any more; to-day it has become a reality, thanks to Braun and Fischer.

For careful study the succeeding steps of the Mandibular Injection have been assembled separately on four Plates, Figures 106-112.

The author expresses his sincere thanks to the Dentists Supply Company, The S. S. White Dental Mfg. Co., as well as to the Kny-Scherer Co. for the loan of electrotypes, and also to the Reberman Co. for the interest shown and valuable assistance given in the publication of this book.

WILLIAM J. LEDERER.

150 East Seventy-fourth Street, New York.

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PART ONE

THE PRINCIPLES AND PRACTICE OF TOOTH EXTRACTION

I

DENTAL AND ORAL OPERATIONS IN THEIR TRUE ASPECT

THE principles of surgery are always the same, no matter to what part of the body they are applied. Different localities of the body vary in degree of susceptibility to infection. Thus the opening of the abdominal cavity or the exploration of the knee joint is attended by more apprehension than the incision of a superficial abscess or the extraction of a tooth; nevertheless, the latter procedures are surgical operations just as the former, and the same rules must be observed.

The late W. D. Miller, in his work on "The Microorganisms of the Human Mouth," collected a list of 165 cases of severe infections following dental and buccal lesions, of which more than 60 terminated fatally. Some succumbed to heart lesions, others developed pulmonary infections, others meningitis, cerebral abscesses, pyemia, septicemia, Ludwig's angina, frontal sinusitis, thrombosis, etc. Those who did not die, carried off syphilitic infections, and those who finally got well went through long suffering and a trying convalescence. These cases were reported by men

like Kirk, Jack, Wilson, Darby, Truman, Marshall and others of like quality.

Von Mosetig-Moorhof, the eminent Viennese surgeon, reports two cases in which extraction of the second right and left lower molars, respectively, was attempted; the first case developed gangrene of the soft tissues, phlebitis, myelitis, œdema of the lungs, and died. The second patient contracted an osteitis followed by phlebitis and pyemia, and also terminated fatally. In both instances the broken-off roots had been extracted, drainage established by deep incisions, but it was too late.

Schwendt reports a case wherein the extraction of teeth was followed by infection of the orbits, resulting in blindness. Baume speaks of a case of an attempted extraction of a six-year molar followed by periostitis, necrosis, pyemia, pleuro-broncho-pneumonia, and death after two weeks.

Many a death certificate reads myocarditis, nephritis, or pneumonia, the patient is laid at rest, and the fact that his death is the result of a tooth lesion is not known either to his physician or his dentist. The certificate really should read "Septic endocarditis produced by streptococci which hailed from an alveolar abscess."

How can such severe conditions result from a localized abscess? Pathology teaches us that

when pyogenic organisms reach the walls of blood vessels they may set up a phlebitis (inflammation of a vein). The endothelial lining of the vessel is broken up, leucocytes collect at these points, and a mass is formed known as a "white thrombus." This thrombus becomes infected with bacteria, and is broken up, loosens, and thus becomes an embolism or a number of emboli. These masses are carried along in the blood stream and may produce metastatic abscesses or infect other structures; thus reaching the right heart, an endocarditis or a myocarditis may result; or the septic masses enter the pulmonary system and produce lung lesions, or they enter the general circulation by the left heart and infect other remote structures.

The researches of Billings and Rosenow, of Chicago, and Hartzell, of Minneapolis, have proven beyond a shadow of a doubt that pyogenic foci in and about the mouth may produce distal lesions. Henry Hemsted, in the London *Lancet* of January 4, 1913, describes a case of streptococcus endocarditis which he positively traces to an abscessed tooth.

Such things being possible, dental and oral operations should be viewed in their true light, namely, as surgical operations, and be carried out accordingly; and the dental and buccal specialist, whether he calls himself dental surgeon, stoma-

tologist, oral surgeon, or dentist, must accept and apply the principles of general surgery.

Surgery is defined as that branch of medicine dealing with disease requiring operative procedures; therefore, any operative procedure in the mouth is mouth surgery. In fact, all operations in the mouth are surgical procedures, excepting the insertion of artificial teeth and the introduction of appliances requisite for the correction of deformities of the teeth and jaws. The insertion of a filling is plastic dental surgery and calls for antiseptic precaution, a principle of surgery; the extraction of teeth is certainly a surgical operation and requires the observation of surgical principles.

II

STERILIZATION

1. *Cleanliness—Asepsis*

THE first principle of successful surgery is the creation and maintenance of asepsis as far as possible. A good deal has been written about sterilization and asepsis. However, the author finds that many men have not learned their lesson well, for he frequently notes a lack of understanding of the basal principles of asepsis among dentists. He has seen good operators sterilize a pair of forceps prior to extraction, and then pausing to re-examine the tooth to be removed, deliberately place the sterile instrument into their operating coat pocket, whence they had drawn a pencil or pad a few moments previously.

Some dry a sterile instrument on a previously used towel. In spite of knowing the meaning of asepsis and sepsis, they lack what Dr. Marshall calls "the sense of asepsis." An operator must not only know the meaning of the word asepsis, he must feel it; it must become part of his physical make-up. Surgical cleanliness spells absolute asepsis (as far as it is possible), as the result of any operation depends in a large measure upon the degree of asepsis under which it is executed.

Asepsis for the mouth specialist means aseptic hands, aseptic instruments, aseptic instrument table, aseptic field of operation. There are dentists who will sterilize their instruments, but fail to properly cleanse their hands, and there are men who carefully observe personal cleanliness, boil their instruments, but fail to sterilize their impression cups. Many keep sterile instruments in filthy dental cabinets; by filthy cabinets I mean highly polished pieces of furniture with felt-lined drawers, full of dust, gold scrap, drugs, sand from polishing discs, in short, filthy drawers and compartments, which become the receptacles for sterile instruments. These instruments unavoidably become tainted.

In how many offices are instruments boiled before using? Dipping into carbolic acid before using is not practical; in fact, all dipping is bad sterilization, unless tr. iodine is used, and this is hard upon instruments. All partial methods of sterilization are bad; they are a little better than no attempt, but they are unscientific and directly criminal toward the patient.

The new departure of instrument houses to construct dental furniture on the lines of surgical furniture is an innovation in the right direction. Dental and buccal operations must be viewed as surgical procedures and carried out accordingly. The white-enamel office is unquestionably the dental of-

fice of the future; it must be kept clean, and the cleaner an operating room the more aseptic. The following is the plan of sterilization pursued by the writer.

2. Care of the Operator's Hands

In surgical cases the hands and arms are brushed thoroughly with hot water and tr. of green soap. Particular attention is given to the nails, which are pared and cleansed with nail file and orange-wood stick. The hands are then rinsed in sterile water, bathed in alcohol, and immersed for some time in a sublimate solution. If rubber gloves are worn, the hands are dried in a sterile towel and powdered with sterile talcum powder and then sterile gloves put on. If there are any cuts or abrasions upon the fingers, these are painted with a coat of collodion. In daily dental practice (ordinary cases) the thorough brushing of the hands and fingers with a good soap and hot water is sufficient. If an operator is treating a syphilitic patient and should injure the skin, the immediate and very thorough massage of the wound with $33\frac{1}{3}$ per cent. calomel ointment is a prophylactic measure against infection. The hands must always be very thoroughly dried before going out to prevent chapping.

3. *Care of Instruments*

All instruments are boiled in water to which a little washing soda has been added. After use they are brushed to remove blood, pus, and tissue residue, and then boiled, dried in a sterile towel and placed in a cabinet. Knives after brushing are placed in lysol, washed in alcohol, and put away. Before using a knife, it is placed in lysol, washed in alcohol, but not dried. The author keeps a test tube half filled with lysol, wherein a knife is placed permanently, always ready for use.

Hypodermic syringes are washed out with sterile water and then kept in 70 per cent. alcohol. Hypodermic needles are cleansed by attaching to the syringe, passing water through, then detaching them, drawing a wire through the cannula, and boiling. After boiling they are placed in pure lysol and kept there until used. Before using, all traces of lysol must be removed by washing first in alcohol and then in sterile water.

Mirrors are brushed and boiled. It is better to increase the mirror bill than to run chances of imperfect sterilization. All instruments are handled with forceps and placed upon a sterile *glass* tray. After use they are placed upon a *metal* tray, which is thrown into the sterilizer with the instruments. The assistant never touches the unused instrument with her hands, always using forceps. This method of sterilization is simple, practical and ef-

fective. It takes but a short time to become accustomed to it, and once acquired demands little effort.

Nerve broaches are passed through a piece of tightly stretched rubber dam to remove adhering tissue, then boiled and rinsed in alcohol for drying. To save time, each instrument which is frequently used should exist in duplicate or triplet form, such as scalers, chisels and excavators. This means a little increased initial expense, but additional safety forever.

Drinking glasses should never be employed, but the always sterile paper cup be in use. Napkins and towels are changed for each patient and sterilized by washing, provided they are boiled in the laundry. The author had his chair covered with rubber cloth slip covers; the chair arms are of enamel; both are washed after a patient leaves the chair. The top of the swinging table should be interchangeable, so that it can be sterilized by washing and wiping it with alcohol after each treatment or operation. This apparent overuse of alcohol may seem expensive, but the writer does not use over \$10 worth of this drug throughout the year, which is hardly worth mentioning in return for the safety felt by both operator and patient.

III

THE RELATION OF THE OPERATOR TOWARD HIS PATIENT

TOOTH extraction appears to be a simple procedure, demanding little skill. If the operator proceeds in this spirit he will soon learn that successful extracting is not merely "tooth pulling," but that considerable skill and judgment are required. It is impossible for any intelligent practitioner to adhere to any fixed set of rules, as every new case differs from its predecessor and patients vary in physical and mental make-up and teeth and jaws differ anatomically.

Before discussing the actual *modus operandi*, the writer desires to speak of a very important factor, namely, the attitude of the operator toward his patient. The first essential for the operator is absolute calmness, for self-control and precision of action will inspire confidence. Never hurry; you cannot extract teeth successfully by the clock. The patient must always feel that the operator is the master of the situation. Sometimes the operator is confronted by a difficult problem and may be at a loss which course to pursue; let him carefully weigh the several possibilities and then proceed. The operator must

never exhibit stage fright or appear overwhelmed by the situation. A kind, gentle word, especially to women and children, will do more to quiet the patient than the pompous, ultra-professional air assumed by some. Kind but firm, never rough or impatient, should be the attitude of the operator. Men's successes can more often be traced to their attitude toward their patients than to exceptional skill or ability. In treating children or extremely nervous patients, some men have recourse to a falsehood, assuring them that this or that will not hurt, thus gaining their confidence, and they perform some painful operation, as the extraction of a tooth or the removal of a pulp. This the writer absolutely condemns. Never tell a patient a lie. Do the least painful work first, gain the patient's confidence, and then he will submit even to necessarily painful operations.

IV

THE EXAMINATION OF THE PATIENT

THE examination of the patient should begin the moment he enters the office, as many objective symptoms, valuable to the operator, can be elicited by careful observation.

Common sense will forbid a long, painful session with a nervously agitated subject, the danger from shock being greater here than in the case of a robust individual. A strong person will withstand the extraction of a number of teeth without an anæsthetic, while a delicate patient may not bear a superficial scaling. A stout asthmatic is as unfit for a long session as a neurasthenic, whose confidence can only be gained by short sittings and the least painful methods. A heart lesion can frequently be noted by the congested appearance of the mucous membrane, club shaped fingers, venosity of the nails, indicating an obstructed circulation. Extreme pallor may indicate anæmia or a weak, inefficient heart. Prominent temporal arteries, standing out like whipcords, indicate a hardened condition of the blood vessels and the radial pulse should be tested, as to the compressibility of the vessels. In these cases it is a wise precaution to determine the blood pressure by

means of the sphygmomanometer, particularly if nitrous oxide is to be administered. The author would refuse the administration of N_2O if the blood pressure is above 180 mm. H_g.

Tuberculosis is often written upon a patient's face, and if pulmonary, the breathing may be the tell-tale. The respiration should be noted; a patient who is coughing is a poor subject for anæsthesia. The diabetic can often be recognized by the odor of his breath.

The short, jerky movements and snappy speech of the neurotic are easily differentiated from the slow motions of the plethoric. By carefully observing a swollen face one can often tell the offending tooth; a necrosis can frequently be detected by its odor. The different types of physical make-up will not obviate a necessary operation, but will modify our methods in some cases. An hysterical patient is better fit for a general than for a local anæsthetic. A keen diagnostician should always use all his senses, be he a physician, a surgeon or a dentist. Everything should be noted about our patients: their appearance, walk, mannerisms, speech, motions, every little detail; this is important in surgical practice, as surgical shock plays a decided rôle in the ultimate success and may prove an important factor in the extraction of teeth, especially as some extractions are severe surgical procedures.

In female patients who are pregnant the advisability of tooth extraction is frequently questioned. The author sums up this much-mooted question as follows: Pregnancy should *never* stand in the way of a *necessary* tooth extraction. It is far better for the patient to be promptly relieved of suffering than to subject her to constant pain, which is a much greater shock, as it is continuous, and therefore accumulative. The careful extraction of the diseased tooth can be done with comparatively little shock, especially if the patient is given an anæsthetic, preceded by a sedative. The author has performed tooth extraction upon women in all stages of pregnancy and has no ill results to report.

This close observation of the patient enables the dentist to better appreciate the physical state of his charge, to coöperate with the physician, if necessary, and to better judge the use of anæsthetics.

It is wrong to make up your mind to examine a single tooth. First study the mouth as a whole; note all the teeth and the articulation. Examine the mucous membrane, as to color and the presence of any lesion upon the lips, the cheeks or tongue. Be on the lookout for any so-called "fever-sores." Make it your business to become acquainted with a typical chancre. Look behind the third molar, and take notice of the pharynx

and the tonsils; study the character of the alveolar process, and then, lastly, examine the tooth to be extracted.



FIG. 1

Examining the Submaxillary and Sublingual Glands

If there is swelling or suppuration present, examine the adjacent glands. (Fig. 1.)

Avoid placing the fingers into the patient's mouth as much as possible; it is pleasanter for the patient and better protection for the operator to use retractors (Fig. 2) or wooden tongue de-

pressors (Fig. 3). These are the cleanest, as they are cheap enough to be discarded after use.



FIG. 2

Examination of the Mouth with Retractors

If a swelling is present, always examine the contour of the jaws, by standing behind the patient and passing the fingers along the border of the jaw from the symphysis toward the angle and

then upward toward the temporo-maxillary joint. (Fig. 4.)

This enables the operator to compare the two



FIG. 3

Examination of the Mouth with Wooden Tongue Depressors

halves of the jaw and also determine the nature of the swelling; whether it is a bony tumor or œdema of the soft parts, and whether or not there is fluctuation present.

If pus is suspected the mere extraction of the

tooth may not give sufficient drainage and the knife will be required.

The fever thermometer and the frequency of the pulse will help to give the operator an idea to what

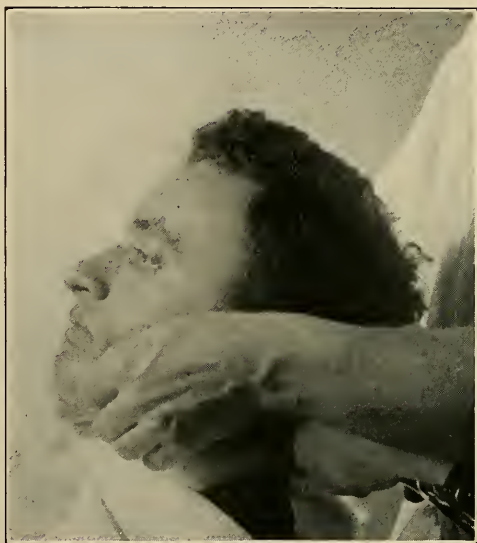


FIG. 4

Examining the Contour of the Lower Jaw

extent the organism is taxed in fighting an infection. If septic material is absorbed, the patient's face assumes a grayish, pasty appearance, and he usually complains of having had chills. The extraction of the guilty tooth is then only part of the treatment, and besides the establishment of

thorough drainage, the elimination of septic material must be accomplished by means of cathartics and the free imbibing of water.

Before operating, the patient's previous history as to hemorrhage should be elicited to bring out the possible presence of hemophilia.

If a number of teeth or roots are to be extracted, it is always best to first make a chart of these, to be certain that nothing is overlooked or forgotten.

V

PREPARATION OF THE PATIENT

THE successful outcome of any operation depends to a large extent upon the physical and mental state of the patient. No operation fills the patients with more apprehension than the extraction of teeth. One reason for this is the fact that the patient is not able to see what is going on. The greater the fear felt by the patient the greater the shock to the nervous system. The extent of shock attending dental operations is very much underrated and is only visible to the careful observer. The sudden blanching of the patient, the frequent and thready pulse, muscular spasms and vomiting are all symptoms of profound shock. Many patients are sent home from the dental office who are really not fit to leave it. A good deal can be done to alleviate shock.

The patient should be in a comfortable semi-reclining position; tight clothing should be loosened, whether an anæsthetic is used or not; the head should be well supported and comfortable, so that the muscles of the neck are not strained. The attendant should always direct the patient to the toilet, as involuntary micturition is not only very embarrassing, but may prove harm-

ful to the patient, particularly in cold weather, for sudden chilling of the pelvis as the result of wet clothing may be the cause of severe illness. Many patients are so agitated as to become hysterical. They tremble and their muscles twitch. This type can be greatly benefited by the administration of sedatives, in the shape of bromides or valerian half an hour before operating. The author has been having very satisfactory results by the administration of Bromural in ten-grain doses. In extreme cases opiates will be of great benefit. The latter should, of course, only be resorted to in extreme cases.

There should be as little preparation as possible while the patient is in the room; everything should be ready when he enters the chair.

To prepare the mouth for any operation it would be wise to have the patient carefully brush the teeth and use an antiseptic wash, but this will not be carried out even under ideal conditions. The writer applies the official Tr. Iodine full strength to the tooth and surrounding structures before applying the forceps. It is true the buccal tissues cannot be sterilized, and they are not as susceptible to infection as other structures, but we must remember that by extracting we create an open wound, which may become an avenue for infection.

VI

INDICATIONS FOR TOOTH EXTRACTION

1. Teeth resisting medicinal or surgical treatment.
2. Teeth causing infection, where the septic focus must be removed hastily.
3. Teeth which have lost their function.
 - a. Teeth which interfere with proper articulation;
 - b. Teeth which cannot be restored by fillings, inlays or crowns;
 - c. Teeth which interfere with the introduction of bridges or dentures.
4. Teeth which are impacted and are the source of trouble.
5. Supernumerary teeth.
6. Teeth which erupt before or shortly after birth.
7. Temporary teeth which are retained beyond their proper time of exfoliation.
8. Single teeth in the upper jaw.

Malposed teeth should never be extracted for the correction of a deformity, unless an orthodontist has been consulted, even if the patient expresses such a desire.

Broken down temporary teeth should not be extracted, unless the seat of infection and beyond treatment. It is often advisable to retain temporary roots in position until the permanent teeth

are "due," even if they cannot be filled *lege artis*; the fact must be borne in mind that such roots are not absorbed.

Too much stress cannot be laid upon these "extraction-don'ts," as many irregularities of the permanent teeth are the result of untimely removal of their temporary predecessors.

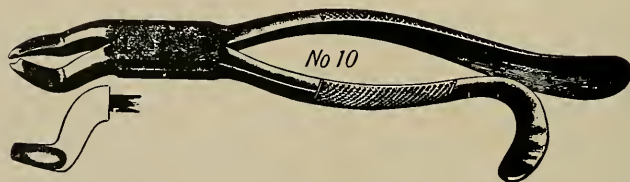
Once it has been decided upon that a tooth be extracted, the operator should carefully examine the diseased organ and note its surroundings, note the thickness of the alveolus, the possible direction of the roots, the degree of attachment, the position of the neighboring teeth. Note whether or not the offending organ is filled and how. If there is a cotton dressing in the tooth, remove same to note whether or not the pulp chamber is open, or perforated, also if the tooth is split, a fact which may escape notice during a casual examination.

In root extractions the gingival border should be carefully examined, and it should be noted if the gum tissues cover or grow into the same. Such growths should be removed before extracting. The resulting hemorrhage can be controlled by Tr. Iodine or Trichloroacetic acid. The consistency of the root, whether it is soft and mushy or hard, should be noted. Most failures in extracting are due to lack of thorough examination before applying the forceps.

VII

THE ARMAMENTARIUM

ONE of the errors committed by many young practitioners is the purchasing of too many forceps; many a pair of these after an idle life in the cabinet finds a more active sphere in the laboratory loosening flask-bolts or doing some other "non-surgical" duty. There are many types of forceps for different teeth, but the fewer forceps an operator gets along with the better. There are individual forceps made for nearly every tooth, and almost all manufacturers have differently shaped instruments, so that there exists really an "embarras de richesse," which, to say the least, to the inexperienced operator is confusing. The writer uses comparatively few instruments, employing the following forceps, made by the S. S. White Dental Mfg. Co. (Figs. 5-12):



For Upper Molars, No. 10; for all other upper teeth, No. 32; for narrow, slender upper roots, No. 65.

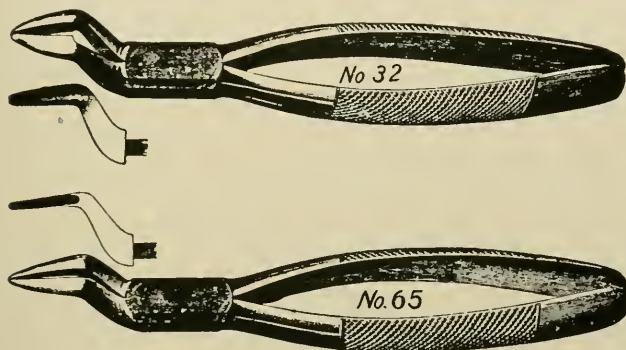


FIG. 5

For all Lower Molars, No. 15; for all other lower teeth, No. 85; for lower teeth in children, No. 101.

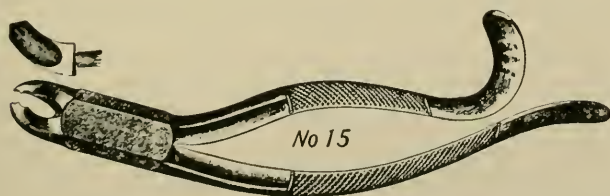


FIG. 6

Forceps used for all Lower Molars on both sides, if pulpal floor is intact, i.e., if the roots are not separated.

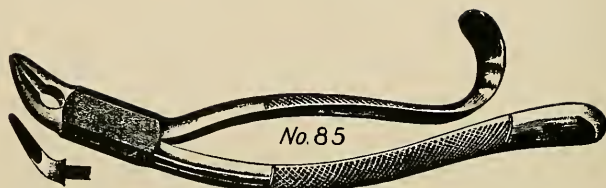


FIG. 7

Forceps used for all lower teeth, except for molars whose pulpal floor is intact; if roots are separated, then these forceps are to be used. Some operators use these forceps for all lower molars, but the writer prefers the No. 15 if the pulpal floor is intact, as it gives a better hold on the tooth.

Forceps used for the extractions of lower children's teeth, No. 101.



FIG. 8.

For the removal of upper narrow roots, particularly slender lateral roots, No. 65.



FIG. 9

The root forceps devised by Prof. Cryer, No. 150 and No. 151, Figs. 10 and 11, prove useful; No. 150, originally designed for upper roots, frequently is the instrument of choice for the removal of third molars in *either* jaw.

Cryer's forceps have to be used with care, as they are very sharp, and if applied with too much force they are apt to fracture the crown.



FIG. 10
Upper Root Forceps After Cryer



FIG. 11
Lower Root Forceps After Cryer

One advantage of the lower Cryer forceps is the sharp angle of the beaks.

A pair of universal root forceps applicable in



FIG. 12

both upper and lower jaw, also very handy for the removal of third molars, are the No. 63.

Besides the aforementioned, the following instruments are required:

Mouth mirrors, these should be "boilable."

Explorers and probes.

Good medium-sized scalpels to incise abscesses (Fig. 13).



FIG. 13

A knife to prepare gum flaps.



FIG. 14
Lederer's Flap Knife*

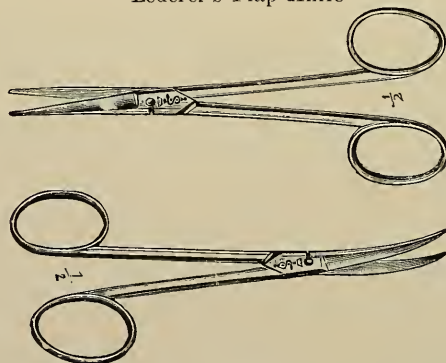


FIG. 15

Shears, both straight and curved, to divide soft tissue. (Fig. 15.)

A good water syringe.

*Obtainable at any Dental Depot.

Mouth Props of various size, of metal, rubber or wood. A large variety can be easily cast in lead or tin. Each prop should be attached to a heavy silk or cotton string and tied to a second prop, so that it can be withdrawn from the mouth if it should become loosened, and that there is no danger of the prop entering the pharynx. The writer has two mouth props connected by metal chains (Fig. 16).

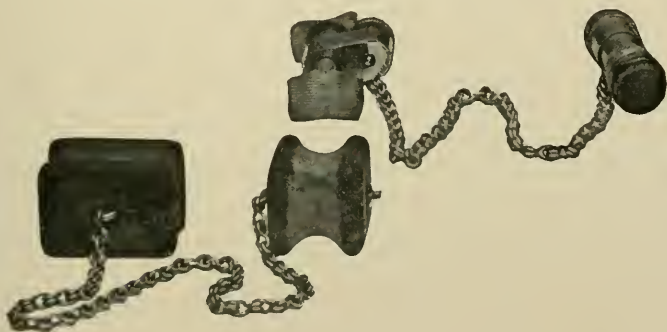


FIG. 16

Several pair of anatomical forceps for grasping soft tissue. (Fig. 17.)

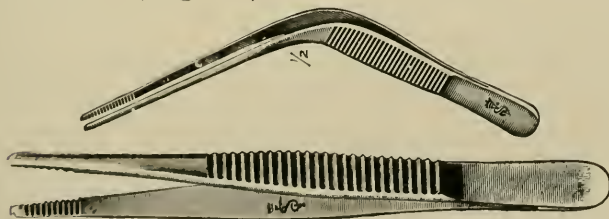


FIG. 17

A mouth gag and oral screw should always be handy, to enable the operator to open the patient's mouth while under an anæsthetic.

The Denhart pattern of mouth gag is very useful and is handy to keep the mouths of children open if the little patients are inclined to resist.

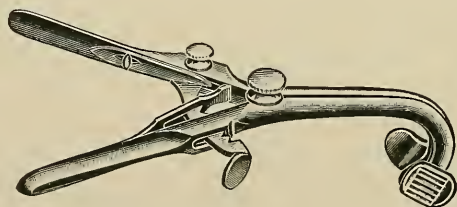


FIG. 18

Denhart Mouth Gag

Children are apt to give the dentist a good deal of trouble. After coaxing, begging and promising the fulfilment of their most coveted wishes, or by threat or force, the little sufferer is made to sit in the operating chair. The doctor by coaxing locates the guilty organ and takes up his forceps to extract, but, quick as a flash, the little fellow shuts his mouth and refuses to part his lips. This is a most trying moment for both operator and parents. In these instances the Denhart gag proves invaluable. By closing the little patient's nostrils, air is cut off and he is forced to open his mouth a bit. If the Denhart gag is now quickly brought between the teeth, pressure upon

the handles of the instrument will pry the jaws apart, and, nolens volens, the forceps can be applied. Great care must be exercised that the instrument is not opened too wide for children, and that the soft parts of the mouth are not injured; the instrument should never be opened unless it is placed between the upper and lower teeth, as otherwise the soft tissues will be traumatized.

Another instrument very useful in treating children is a metal finger protector, which slides over the operator's left index finger and is placed into the patient's mouth. It protects the operator against being bitten by the little one, and being of metal, it keeps the jaws apart.

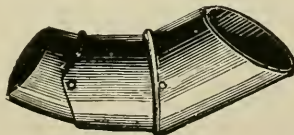


FIG. 19
Metal Finger Protector



FIG. 20. ORAL SCREW

A pair of tongue forceps in case the tongue should fall back.

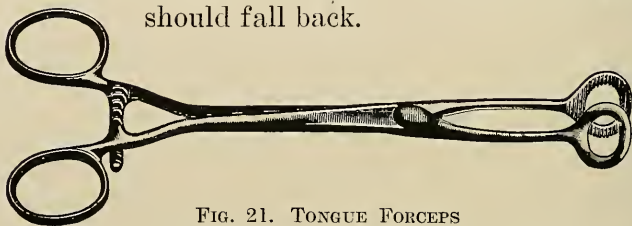


FIG. 21. TONGUE FORCEPS

Chisels for cutting bone, as well as a mallet and a set of retractors for retracting the lips, cheeks and tissue flaps. Periosteal elevators to raise soft tissues and periosteum. (Figs. 22-23.)

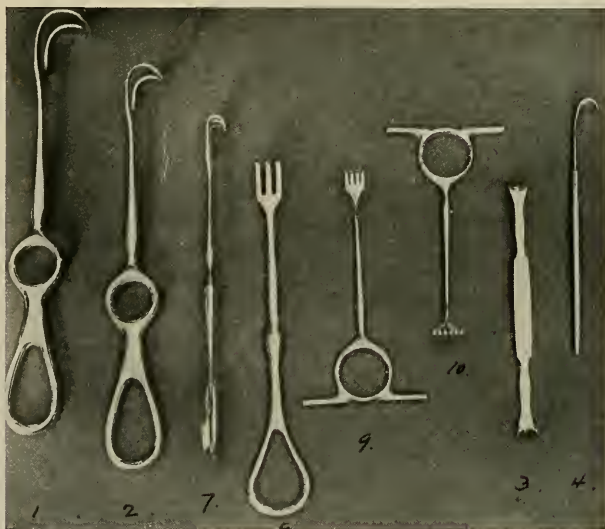


FIG. 22

Retractors 1, 2, 3, 4, 7, 8, for Lips and Cheeks.



FIG. 23

1. 2. Chisels with Curved Cutting Edge. 3. with Straight Cutting Edge. 4. 5. for Cutting Out Molars. A. B. C. Periosteal Elevators.



FIG. 24

A Powder Blower for Orthoform or Iodoform.

A good headlight is a very necessary requisite; the ample illumination of the oral cavity is essential, and at times proves very difficult without the lamp (Fig. 25).



FIG. 25. HEADLIGHT

A cautery operated by electricity or benzine.

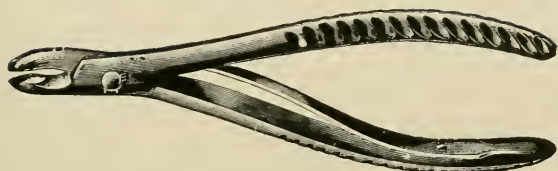


FIG. 26

A pair of bone-cutting forceps (Rongeur) to cut away sharp edges of bone. (Fig. 26.)

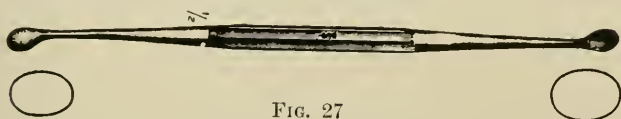


FIG. 27

A good double-end curette to remove granulations and soft bone tissue. (Fig. 27.)

Mastoid curettes are also quite useful.

DRESSINGS

Iodoform gauze in strips one-half and one inch wide for packing.

Plain sterile gauze.

Gauze bandages two and one-half inches wide.

Rubber tissue.

Cotton swabs.

These are best made by winding a little cotton around one end of a toothpick.

Adhesive plaster strips one-half to one inch wide.

Cheese-cloth sponges; these can be made at home, as shown in Fig. 28.

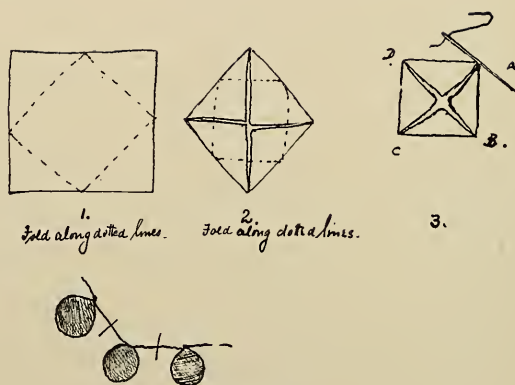


FIG. 28

They are made by cutting cheese cloth into pieces one and one-half inches square, and folding over the four corners; the resulting corners are folded over again, and the new corners formed A.B.C.D., are drawn together by a strong thread, the tampon thus forming a ball. A number of these are made on one thread and then cut apart.

The following drugs should be handy:

Hypodermic tablets.

Strychnine Sulphate, gr. 1/60.

Morphine Sulphate, gr. 1/8.

Morphine Sulphate, gr. 1/8, and Atropine Sulphate, gr. 1/150.

Aromatic Spirits of Ammonia (Aromatic Ammonia, Vaparole, Burrows Welcome).

Amylnitrite in globules (glass pearls holding 3 and 5 minims, which are broken in a napkin and inhaled by the patient).

Bromides. Bromural (Knoll & Co.), five-grain tablets.

Adrenalin chloride 1:1000.

Iodoform powder.

Orthoform.

Novocain.

Thiersch Solution.

Saline Solution.

Burrows Solution.

Boric Acid Solution, 2 per cent.

Iodine.

Alcohol.

Bicarbonate of Soda.

Hydrogen Peroxide.

Nitrate of Silver in 5 per cent. Solution.

Nitrate of Silver in Crystals.

Carbolic Acid.

Lysol.

A tube of Ethyl Chloride.

A jar of 33½ per cent Calomel Ointment.

A jar of 5 per cent. Ichthyol Ointment.

A jar of 10 per cent. Ichthyol Ointment.

A jar of Vaseline.

VIII

CLASSIFICATION OF CASES

TOOTH extractions can be divided into:

1. Normal extractions.
2. The removal of roots.
3. The removal of impacted teeth.
4. The removal of unerupted teeth.

A normal extraction is one performed upon a tooth which has sufficient crown structure present to enable the operator to grasp the tooth with forceps and remove it without difficulty.

Root Extractions are subdivided into:

Normal and surgical.

A normal root extraction is one performed upon a root which can be grasped by forceps (or luxated by an elevator) and removed without difficulty.

A surgical root extraction is an operation in which the knife, chisel or burr must be employed to remove overlying tissue when extracting a root; these are distinctly surgical procedures and must be carried out accordingly, observing strict asepsis and subsequent proper after-treatment of the wound.

Impacted teeth are designated as such when engaged or incarcerated by adjoining teeth or con-

tigious structures, as the ramus of the mandible or the tuberosity of the upper jaw.

Unrupted teeth are such when covered by soft or hard tissue or both.

These different types of operations demand a varying technique; nevertheless, all extractions are governed by principles, based upon physical laws, which demand observation.

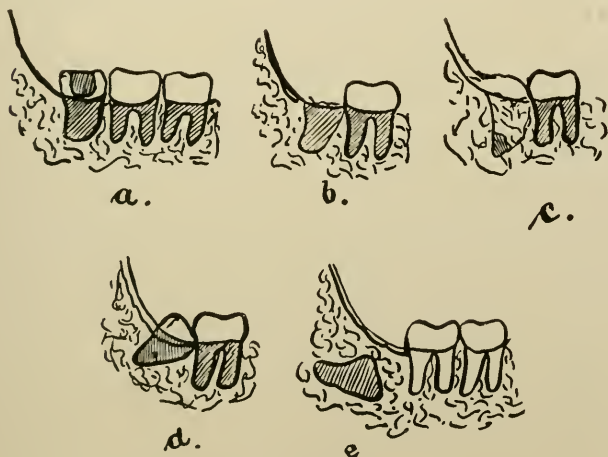


FIG. 29

Illustrating the Various Types of Extraction Diagrammatically —a, Normal Extraction; b, Normal Root; c, Fractured Root; d, Impacted Tooth; e, Unrupted Tooth.

IX

THE TECHNIQUE OF NORMAL TOOTH EXTRACTION

For convenience in teaching, the writer divides the operation of tooth extraction into four stages:

1. The grasping of the forceps.
2. The application of the instrument.
3. The closing of the instrument about the tooth.
4. The actual removal of the tooth or root.

It is important for the student to carefully master these different steps, and though no rigid rules can be laid down for the extraction of teeth, the various steps must be executed correctly, as they depend upon *physical laws*, and these must be observed if success is to be attained.

The forceps should be grasped and placed



FIG. 30
Placing the Forceps Loosely Across the Hand

loosely across the hand, as shown in Fig. 30. The instrument should not be grasped tightly, as ease of manipulation and control over the instrument are lost, both of which are necessary for a successful operation.

In holding upper forceps, the fingers are now curved about the handles, the index finger being placed between the same. The index finger is slightly extended and the forceps are thus opened (Fig. 31). The other fingers, curved about the handles, prevent the forceps from opening too far.



FIG. 31

Bringing the Index Finger Between the Handles, Thus Opening the Forceps, the 3, 4, 5 Finger Being Curved About the Handle.

The hand is now rotated and the beaks applied bucco palatally to the cervical portion of the tooth, pointing the distal part of the instrument away from the median line (Figs. 32, 33, 34).

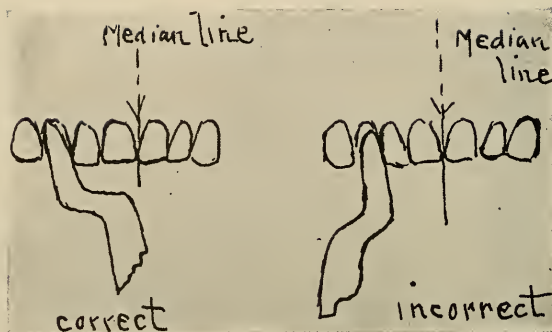


FIG. 32

Application of Beaks to Tooth That the Distal Part of Instruments Points Away from Median Line.



FIG. 33

Application of Forceps to Crown of Tooth



FIG. 34

Closing Forceps About Tooth. The Index Finger Has Been Withdrawn from Between the Forceps Handles and Has Been Curved About the Instrument.

The forceps are so adjusted that the *long axis of the beaks runs parallel with the long axis of the root.*

This constitutes the second stage of the operation and is one of the steps important to be observed. If the forceps are applied incorrectly, the force used first in driving the forceps home and then in extracting the tooth will travel in a wrong direction and frequently cause the tooth to fracture or produce unnecessary mutilations or both.

Fig. 35 represents a pair of forceps *correctly* applied to a Left Upper Canine.

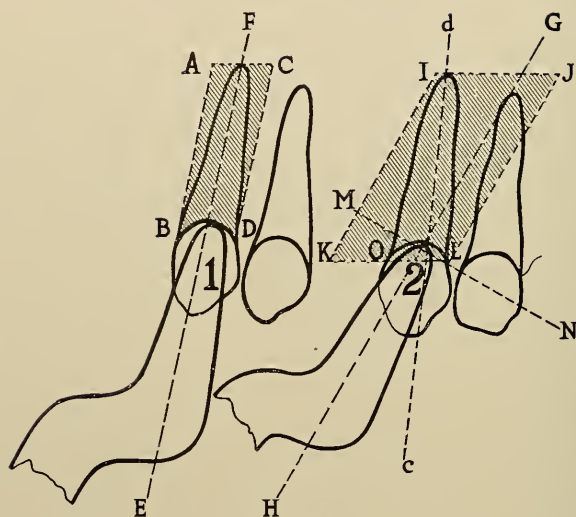


FIG. 35

E.F. indicates the long axis of both the tooth the forceps-beaks; it also shows the path in which the force, requisite to drive the instrument home and to extract the tooth, will travel.

A.B.D.C. is a rectangle which represents diagrammatically the area or amount of resistance offered to the operator.

2. represents the same forceps applied *incorrectly*.

c.d. represents the long axis of the tooth.

H.G. represents the long axis of the forceps-beaks (not parallel to c.d.). H.G. also shows the path along which the applied force will travel.

I.K.L.J. represents the area or amount of re-

sistance to be overcome, which is about three to four times greater than in the preceding illustration.

The "area of resistance" is obtained by marking the widest cervical portion of tooth embedded in bone B.D., then drawing a line marking the long axis of the tooth E.F. and a tangent to the apex of the root A.C., parallel to B.D. Now lines are erected at B. and D. parallel to E.F. and extended upward till they intersect the tangent A.C.; this gives us A.B.D.C. (shaded portion) and expresses diagrammatically the area of resistance to be overcome in extracting the tooth I.

That the forceps-beaks are incorrectly applied to Canine 2 is shown by the fact that the long axis of the beaks H.G. does not run parallel with c.d., the long axis of the tooth; we, therefore, get a much greater "area of resistance" (shaded portion), and the tooth is apt to fracture at M.N., or in exerting sufficient force to overcome the resistance offered by the solid block of tissue K.L.J.I. the alveolus will splinter or other injury result, without (in many cases) the tooth leaving the socket.

The "area of resistance" may appear rather "theoretical"; the writer, however, has seen this theory demonstrated, as a fact, in the mouth innumerable times; both in the lower and upper jaws. Its object is to impress the student with the importance of correct forceps application.

After the forceps have been applied correctly, the index finger is withdrawn from between the handles and placed on top of the middle finger, the thumb is brought around the handles and the beaks closed about the tooth. (Fig. 36.) This terminates the third stage of the operation.



FIG. 36

After the Forceps Are Properly Applied and the Index Finger Is Placed on Top of the Middle Finger, the Thumb Is Brought Around the Handle and the Beaks Closed.

In closing the forceps too much force should not be exerted, as the tooth will then be fractured by the sharp beaks. The forceps should be closed just tight enough to join tooth and forceps. In fact, we must look upon forceps as elongations of our fingers. Hand, forceps and tooth must become one object.

The fourth stage of the operation, the actual removal of the tooth from its socket, is neither a jerking nor pulling process, but rather, first, the determination of the direction of least resistance by luxation, and then a teasing of the tooth out of its socket, by an inward and outward motion.

In removing a tooth from its alveolus there are two forces to be overcome :

1. The pericemental attachment.

2. The mechanical insertion of the tooth in its socket. The latter is particularly marked in multi-rooted teeth and is well illustrated in old skulls, wherein the pericementum is dried up and plays no part in the retention of the teeth ; still they are retained by the shape of their roots, as a peg is held in a board—by adhesion. Bearing these two “retentive factors” in mind, we formulate the actual extraction accordingly.

The pericemental attachment is broken up by driving the root into the socket, then luxating the same inward and outward and then continuing this rocking motion till tactile sense indicates the

direction of least resistance and actually teases the tooth out of its socket.

As we use bayonet forceps for all upper teeth, this technique applies to all teeth in the upper jaw.



FIG. 37

Shows Application of Forceps to Right Upper Third Molar;
Note Left Thumb and Index Finger Protecting Soft Parts.



FIG. 38
Shows Application of Bayonet Forceps to Upper Anterior Teeth;
Note Position of Fingers of Left Hand Protecting Soft Parts.



FIG. 39

Shows Application of Forceps to Left Upper Third Molar; Note Left Thumb and Index Finger Protecting Soft Parts.

In extracting lower teeth, the forceps are grasped and also placed loosely across the palm of the hand (Fig. 40); the index finger is then introduced between the handles (Fig. 41), the other fingers being placed about the handle. The thumb is now extended along the shank of the instrument (Fig. 42); the beaks are then applied to the crown of the tooth, by tilting the beaks downward so as to bring them in a parallel position with the long axis of the tooth (Fig. 43). The index finger is withdrawn from between the handles, placed above the middle finger, and the thumb is kept

extended, the forceps are closed (Fig. 44), and the tooth luxated and withdrawn.

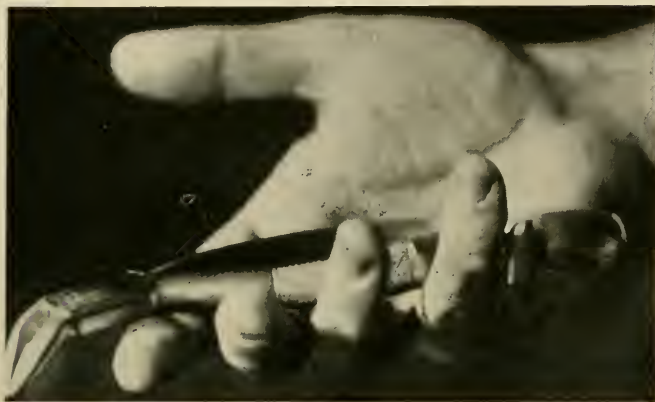


FIG. 40

Holding Lower Forceps, First Stage, Placing Instrument Loosely Across Palm of Hand.



FIG. 41

Introducing Index Finger Between Handles to Open Forceps



FIG. 42

Showing Position of Lower Forceps as They Are Being Applied to Tooth. The Index Finger Is Still Between the Handles, the Thumb Extended Along the Shank of the Instrument.



FIG. 43

Shows the application of Forceps to a Lower Bicuspid. The Index Finger Has Been Withdrawn, Placed Above the Middle Finger, and the Thumb Extended Along the Shank of the Instrument. Note the Parallel Application of the Beaks to the Long Axis of Tooth.



FIG. 44

Shows Last Stage of Application of Lower Forceps, the Index Finger Has Been Withdrawn from Between the Handles, the Thumb Is Extended Along the Shank, the Beaks Are Closed About the Crown of the Tooth.

With lower forceps, where the handles and beaks form an angle, the handle must be raised sufficiently high, that the beaks become a continuation of the roots (or that the long axis of the beaks runs as nearly parallel to the long axis of the tooth as possible) ; not observing this accounts for many failures.

Lower molar forceps should be so applied that the pointed portion of the blades strikes the bifurcation of the roots as nearly as possible.

The curved blades of the lower molar forceps should enclose the bifurcation of the root, and unless there exists an ankylosis, the roots are badly

curved on diverging; there is little chance for failure if the tooth is properly luxated (Fig. 45).

The application of sudden force by jerky movements or pulling will snap off the crown or tire the operator rapidly, cause a sore hand and fail to dislodge the tooth.

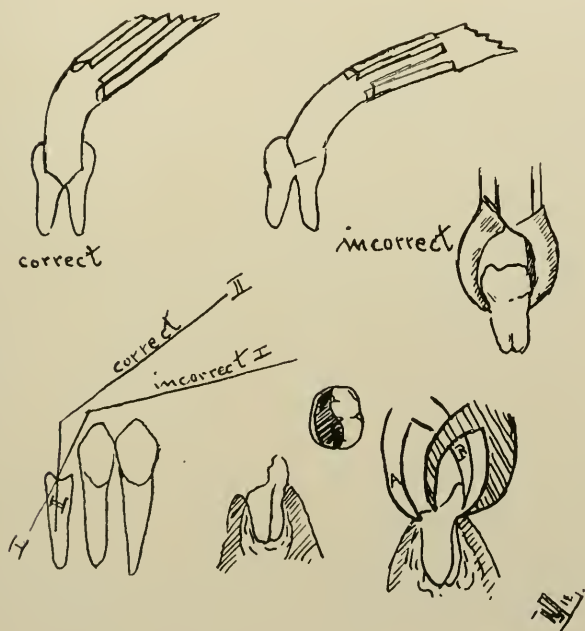


FIG. 45

Forceps Correctly and Incorrectly Applied to Lower Teeth



FIG. 46

Shows Application of Forceps to Lower Anterior Teeth; Note Left Thumb Supporting Mandible, and Index and Second Fingers Protecting Soft Parts.



FIG. 47

Shows Application of Forceps to Left Lower Molar; Note Direction of Beaks, Parallel to Tooth, Fingers of Left Hand Supporting Mandible and Protecting Soft Parts.

The teeth in the jaws form an arch, of which each tooth is a keystone, excepting the last molars. The extracting force should, therefore, be exerted buccally, i.e., away from the arch, excepting sometimes in lower molars. This, however, is no fixed rule, each case being governed by individual conditions.



FIG. 48

Shows Application of Forceps to Right Lower Molar; Note Fingers of Left Hand Protecting Soft Parts.

So, after all, if all points necessary for successful tooth extraction are considered, the operation is not merely pulling, but a complex procedure. To recapitulate one has to bear in mind:

1. Grasping of the forceps, not tightly, but loosely.

2. Correct application of the forceps-beaks to the tooth. Long axis of beaks, parallel to long axis of the root.

3. Closing of forceps, not too tightly; join hand, forceps and tooth into one.

4. Correct application of force upward or downward, then in, and outward, to break up pericemental fibres and thus loosen the roots in their alveoli, and then continue the in and outward motion, gaining the direction of least resistance—then removing the tooth, never losing control over the instrument.

Having considered the general principles of Normal Extractions, a few words regarding the position of the operator will be in order.

Different operators assume various positions while extracting.



FIG. 49
Position of Operator While Extracting Upper Left Anterior Teeth



FIG. 50

Position of Operator While Extracting Right Upper Posterior Teeth

The writer usually stands at the right side, facing his patient, except while removing teeth from the left side, both upper and lower jaws, when remaining at the same side he will turn around, so as to stand parallel to the patient. (Figures 49-54 illustrate this better than words.)

The writer never stands behind the patient, as it is easier to remove teeth from the alveoli facing the patient. The teeth forming an arch in the jaws, Figures 56 and 57, will demonstrate that it will require less force and effort on the part of the operator to dislodge a tooth labially or buccally standing in front (Fig. 57) than standing behind the patient (Fig. 56), as the operator has to use his wrist, elbow and shoulder joints and is working overhand or indirectly, while when he faces the patient he works directly and only uses his wrist and elbow.



FIG. 51

Position of Operator While Extracting Right Lower Posterior Teeth



FIG. 52
Position of Operator While Extracting Lower Anterior Teeth



FIG. 53

Position of Operator Extracting Left Upper Posterior Teeth



FIG. 54

Position of Operator Extracting Left Lower Teeth (Sometimes the Writer Will Stand as in Fig. 51).



FIG. 55

Standing Behind the Patient



FIG. 56
Standing in Front of the Patient

Whichever position the operator may take, whether in front, behind or at the side of the patient, one point is very important to remember: the mandible of the patient should always be well supported during an extraction, as the force necessary to grasp and luxate a tooth, projected to the temporo-maxillary joint, may cause a subluxation, or even a dislocation, if the lower jaw is not firmly held with the left hand. It is even possible to cause a fracture of the condyloid process by ruthless extraction, if the mandible is not well supported.

X

THE EXTRACTION OF ROOTS

No CLASS of conditions will test the skill of the operator more severely than the successful extraction of roots. Those roots which can easily be reached by forceps or elevator will not prove difficult, but roots, fractured below the level of the alveolar process, roots malposed or curved, may at times tax the utmost skill of the most experienced operator, and their successful removal frequently proves to be more difficult operations than many major surgical procedures.

For the extraction of upper single roots, bayonets No. 32 and No. 65 will usually suffice; in some instances No. 150 will be valuable. For the mandible No. 85 and No. 151 answer the purpose. Upper molar roots united by pulpal floor, the writer attempts to remove in one operation by driving the No. 10 forceps between gum and bone as high as possible.

If necessary, the gum is separated from the alveolar process by making a flap on the facial and palatine aspects (Fig. 58).

If the roots are separated they are treated as single roots and removed with the narrow bayonet individually. For lower molar roots which

are not divided, the No. 15 lower molar forceps are employed; if divided, No. 85 and No. 151 prove useful; a fixed rule cannot be laid down, however, and the individual case must decide the best instrument in a given case.

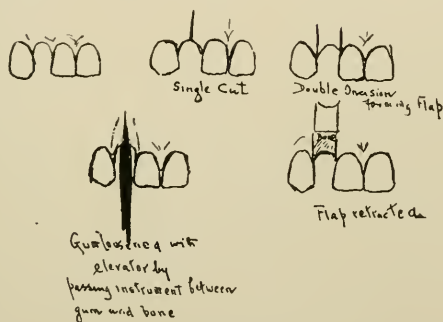


FIG. 58

If a root is decayed or fractured below the level of the alveolar border, it is the writer's practice to incise the gum parallel to the root facially and lingually, and then force the instrument between the gum and the bone, cutting through the alveolar process, if necessary. When grasping the root, *never include the soft tissues within the beaks of the forceps.*

To cut soft tissues with the forceps is brutal, unscientific, unsurgical, unnecessary and harmful to the patient, for it is not cutting, but tearing tissue.

It is an established fact that incised wounds heal

by first intention or primary union, while lacerated wounds heal by granulation, which is a longer process; besides, a lacerated wound becomes infected more often than an incised lesion. It is important to remember in the extraction of roots that gum tissue should *never* be torn, but always incised by means of a knife or scissors.

Fig. 59 illustrates the correct and incorrect procedure in these cases.

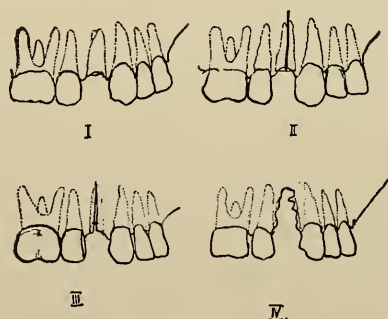


FIG. 59

I. Shows the First Bicuspid Root in the Alveolus. II. Shows the Gum Incised. III. Shows the Appearance of the Tissues After Extraction Following Proper Incision. IV. Shows the Appearance of the Parts After the Extraction, if the Operator Does Not Incise the Gum First, but Includes the Soft Tissues Within the Blades of the Forceps.

If the root is a molar root two parallel incisions can be made, and thus a flap prepared, which is loosened with the lower end of the flap knife or periosteal elevator, and the forceps are then driven well below the gum. For cutting gum tis-

sue the author devised a knife shaped like a chisel, which will not nick when brought to bear upon bone. The lower end is shaped like a periosteal elevator with which the gum flap is separated from the bone. Fig. 14. The knife can be sharpened on an Arkansas stone.

Elevators, which are really but one beaked single-handled forceps or gouges, prove very useful at times, but must be employed very cautiously, as a slipping elevator can do a great deal of harm. The instrument is held in the right hand and grasped as short as possible; the left hand should always protect the surrounding tissues, so as to avoid slipping.



FIG. 66

Elevators Used by the Author. The Right and Left Instruments Are No. 13 and No. 14, S. S. White. The Other Three, European Instruments. The One at the Extreme Right Is *Partsch's* Elevator, Particularly Adapted for Removal of Lower Roots. The One Next to This Is *Lecluse's* Elevator, and the One in the Center *Berten's* Elevator.

The blade of the instrument is then forced between root and alveolus, so as to force the root out of its socket. There are many types of elevators, and it makes really no difference which one is employed, as long as the desired end is accomplished, i.e., the removal of the root with no damage to adjacent tissues. The writer uses the instruments shown in Fig. 60. Figs. 61-65 demonstrate the use of elevators.

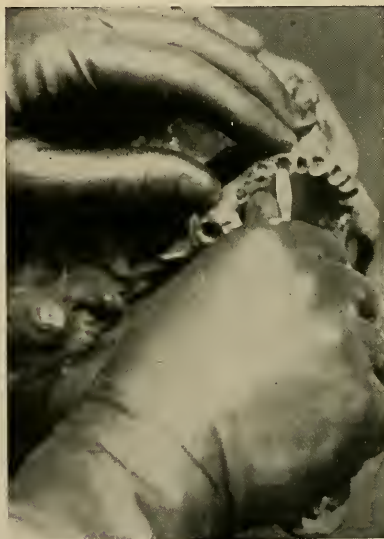


FIG. 61

Shows the Manner of Using an Elevator in the Upper Jaw. The Instrument Is Applied to an Empty Alveolus to Demonstrate Its Use. Note the Position of the Thumb of the Right Hand; the Same Is Resting Upon the Palate; this Steadies the Hand and Prevents Slipping of the Instrument. The Left Hand is Employed to Retract the Lips and Cheek. The Instrument Is Held Very short.



FIG. 62

Elevator Applied to Tooth, Right Side Lower Jaw

In using elevators it must be borne in mind that these instruments are used as levers, and considerable force is required to dislodge a root; if such an instrument slips, it is apt to do considerable damage to the patient, as perforating the cheek or the palate. *An elevator should never be rested upon or against an adjoining tooth.* It, therefore, is necessary to have full control over the instruments. Soft parts should always be drawn out of the way.

Cases often present instances where the frac-



FIG. 63

Employing Elevator to Gouge Out Tooth—Left Lower Tooth. Note Thumb of Right Hand on Shank of Instrument. Left Hand Protects Tongue, Lip and Cheek on That Side.

tured root lies so deeply embedded in bone that it is impossible to reach it with forceps or elevator; in these cases the gum and periosteum are incised, so as to form a flap, which is separated from the bone by a periosteal elevator and held by a retractor or tenaculum, thus exposing the bone. The bone is then removed with engine bur or chisel until the root is sufficiently exposed to enable the operator to remove it with elevator or forceps. If a chisel is used, it is ad-



FIG. 64
Elevator Applied to Tooth in Left Upper Jaw

visible to let the patient bite on a rubber mouth prop, as this reduces the shock of chiseling.

In operating upon cases where the gum is to be retracted and bone removed, the great drawback to an only fairly speedy operation is the incessant hemorrhage, which constantly occludes the field of operation. As many, in fact most of these cases, are operated under local anaesthesia by the use of



FIG. 65

Using Elevator to Gouge Out Right Upper Root. Note Position of Right Index Finger and Position of Left Hand and Fingers.

novocain and adrenalin, the vasoconstrictor property of the last-named drug serves to good purpose. This, however, is not sufficient to do away with all the annoyance of bleeding; constant swabbing by an assistant with sterile gauze sponges is essential to keep the field of operation suffi-

ciently free from blood so that the operator can proceed with any degree of certainty. These gauze sponges must be prepared in advance, and several hundred should always be on hand ready for use. A few illustrations will show the most common root extractions and the methods employed. Fig. 66 shows a case wherein a root is so crowded in the alveolus that it proved impossible to remove it. The cause of its resistance to ordinary methods was brought out by the radiograph. With the X-ray in possession, a flap operation was decided upon, and after burring away the anterior alveolar wall the molar root was easily removed. Cases of this type indicate the extreme

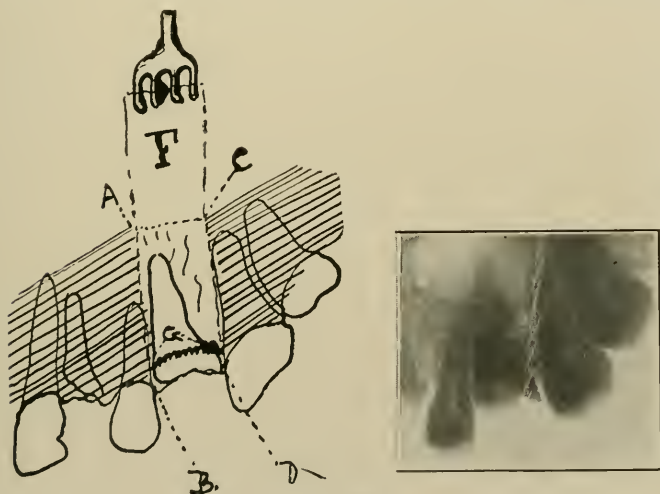


FIG. 66

value of the X-ray. The writer makes it routine practice to demand an X-ray if a tooth or root offers resistance to ordinary methods.

The steps of such an operation are:

1. Sterilization by Tr. Iodine.
2. Induction of anæsthesia.
3. Incision A-B.
Incision C-D.
Incision B-D.
4. Loosen flap with raspatory.
5. Retract flap of gum and periosteum F. by means of retractor.
6. Bur away alveolar process at G. until lower portion of root is exposed.
7. Extract root by means of suitable forceps.
8. Wash out wound with boric acid, and be sure to remove all loose spiculæ of bone.
9. Blow powdered iodoform into wound.
10. Replace periosteal and gum flap.
11. Suture into position, if necessary, or pack wound.

The removal of pieces of molar roots in the mandible may prove a very delicate operation, as in the case shown in Fig. 67; here the abscessed area was situated directly above the inferior dental canal; the whole mandible was constructed along delicate lines, and the brutal method of crushing out the root might have resulted in:

1. An infection of the mandibular canal.

2. An injury of the Inferior Dental Nerve, causing neuralgia. It also had to be borne in mind that the mandible in this region is very thick, and the attempt to crush out a root must necessarily result in considerable bone injury, which in turn can be productive of a periostitis of the jaw, or, what is worse, osteomyelitis. The slower method of dissecting the soft tissues away, elevating the periosteum, exposing the bone and then carefully removing the overlying osseous tissue till the roots are exposed, is the more conservative, safer and surer method.



FIG. 67

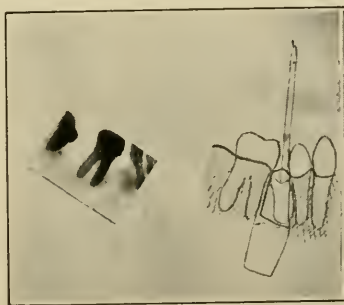


FIG. 68

Fig. 68 shows another class of cases met with not infrequently; the technique is also the preparation of a muco-periosteal flap, exposing the bone and then removing sufficient of the anterior alveolar wall to enable the operator to remove the root.

XI

THE REMOVAL OF IMPACTED TEETH

TEETH are designated as impacted when engaged or incarcerated by adjoining teeth or contiguous structures, as the ramus of the mandible or the tuberosity of the upper jaw.

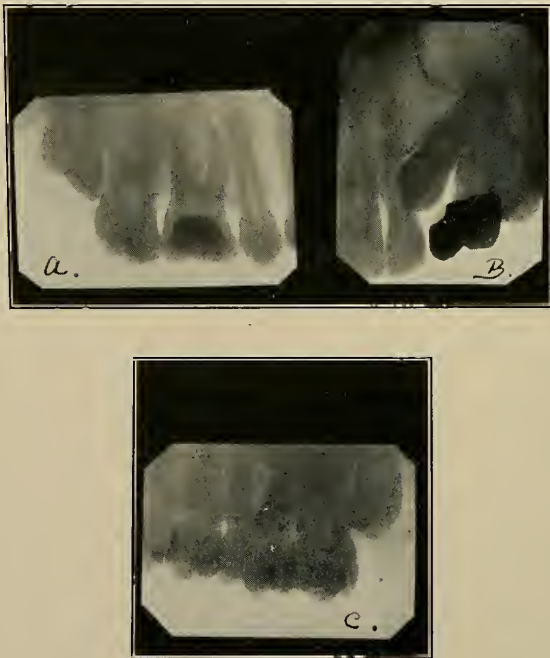


FIG. 69

The successful termination of these cases requires a good deal of judgment, as each case demands individual treatment, and there are many types and degrees of impactions. It is impossible to classify all impactions, but we can divide them primarily into two groups:

1. Those teeth whose crowns alone are engaged or incarcerated.
2. Those teeth whose crowns and roots are engaged or incarcerated.

The first class of conditions is usually due to rotation of teeth in their sockets (Fig. 69C).

The second type is usually caused by tilting of teeth or faulty eruptions (Fig. 69B).

It is evident that the first class of conditions is more easily coped with than the second division.

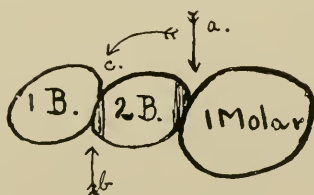


FIG. 70

For example, take Fig. 69c. Let us suppose that the second bicuspid were to be removed. This would prove a difficult extraction, as the teeth are crowded and the tooth is slightly rotated in its socket. If viewed from the morsal aspect, the crowns would appear as in Fig. 70.

The forceps applied in the usual fashion and force exerted in the accepted manner, palatally and buccally, indicated by arrows (a) and (b), both adjoining teeth 1B and 1M would offer resistance, the molar toward the palate, the first bicuspid facially. Sufficient force employed to loosen the second bicuspid would also luxate the molar and first bicuspid. To extract the second bicuspid successfully would necessitate the loosening of the

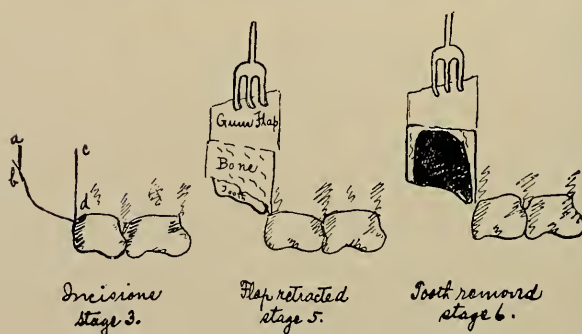


FIG. 71

tooth by rotation (arrow c) or the cutting away of the shaded portions of its crown, so as to disengage it from its neighbors. Rotation is not always practical, as in its attempt the tooth is frequently fractured. The disengagement of this tooth by bur or disk is the logical procedure; after freeing the crown, the tooth is extracted in the usual manner. Sometimes it is easier to crush or amputate the crown first, particularly if it is carious, and then extract the root.

To remove the impacted third molar (Fig. 71) appears easier in the radiograph than it proves in reality. Judging by the X-ray, it seems rather simple to remove these teeth, say, with a pair of upper Cryer forceps, but we must not forget that on the skiagram we do not look "at" things, but "through" them. The motto of the writer is, "Never to operate in the dark"; "Always see what you are doing"; and, therefore, he advocates the "Open" or flap method. Fig. 71 illustrates the operation.

STEPS OF THE OPERATION

1. Sterilization by Tr. Iodine.
2. Anæsthesia (local).
3. Incisions a.b.c.d. and b.d. down to the bone.
4. Loosen gum and periosteum with raspatory.
5. Retract flap E, exposing bone.

6. Chisel or bur sufficient bone away to expose enough tooth so that it can be removed with forceps or elevator.

7. Cut away all rough edges of bone.

8. Wash out bone cavity with boric-acid solution to remove all spiculæ of bone.

9. Blow iodoform into bone cavity; pack with iodoform gauze.

The bleeding, which proves very objectionable, is controlled by the suprarenin, which is combined with the local anæsthetic always used in these cases and the constant swabbing with sterile tampons. Fig. 69b illustrates another type of impaction, which in reality comes under the heading of unerupted teeth, and will be considered in due time.

The most frequently occurring impaction is that of third molars, the lower teeth exceeding the upper in frequency.

The impacted lower third molar occurs in all "shadings"—from being slightly engaged by the second molar to complete incarceration by both anterior tooth and ramus of mandible. Fig. 72.

The technique of operation in its removal varies with each case. One factor, however, should *never* be overlooked, and that is the radiograph. By the X-ray alone we can determine with any degree of accuracy what condition confronts us, and a case which may appear very difficult will



FIG. 72

prove to be rather easy, while a very innocent-looking impaction will reveal its real character by skiagram only.

Some operators advise the removal of the twelve-year molar in lieu of doing a difficult third molar extraction. This the writer is not in favor of, for the following reasons:

1. We never know if the released third molar will advance into proper position.
2. The opposing twelve-year molar is robbed of its properly articulating opponent.
3. In many cases the third molar is diseased, and thus a healthy, useful tooth is sacrificed for a diseased organ.
4. The articulation is spoiled.

Some operators remove both the twelve-year molar and the wisdom tooth; this the writer considers malpractice. The only indication to a sacri-

fic of the twelve-year molar for a third molar is present in patients who are in very delicate health and so debilitated that a short operation is imperative; also where the third molar is in good condition, while the second molar is diseased.



FIG. 73

The operation for removal of the impacted tooth shown in Fig. 73 is one of the most difficult impactions which the oral surgeon is confronted by. The technique is that of the open-flap opera-

tion, aided by removing the overhanging portions of ramus by means of bur or chisel.

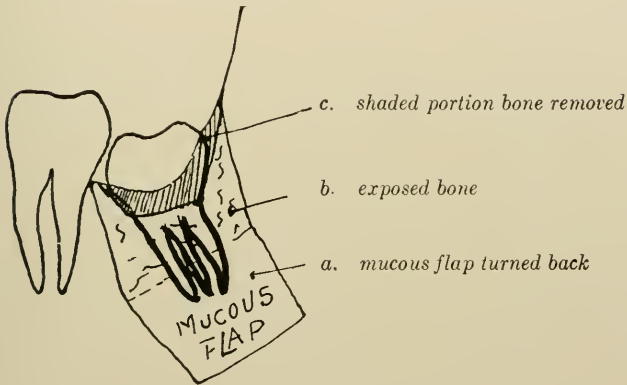


FIG. 74

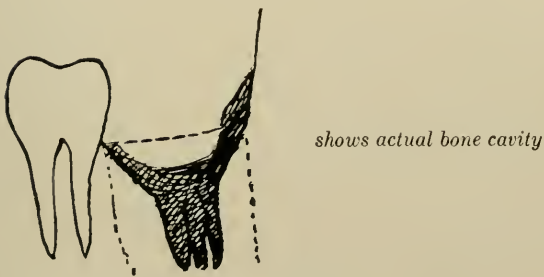


FIG. 75

Fig. 74 shows the method of operation.

Fig. 75 the actual loss of bone tissue, which is less in extent than if an attempt is made to

“crush out” a tooth of this type or remove it by brutal force.

Some operators object to the open-flap method because they claim that the removal of bone by drill or chisel endangers the integrity of the second molar. The writer claims that the open-flap method is the only reasonable method to employ, as the operator sees what he is doing. The operation is not “an artistic performance” on paper alone, but if carefully and slowly done, a practical procedure, if carried out along surgical lines. It is a delicate operation, but if a cataract can be removed without injury to the eye, why should a tooth not be freed from impaction? The writer always follows this method with gratifying results.

The next teeth in frequency of impaction are the bicuspid.

All impactions can be overcome by employing this method, i.e., by dissecting away overlying gum tissue, in shape of a flap, which serves a double purpose. First, it conserves the integrity of the soft parts, creating an incised wound; and, secondly, the flap acts as a protection to the bone cavity after operation. The incisions may vary, the flap may be differently shaped, but the method of procedure is always the same where the roots of a tooth are engaged.

Some teeth are impacted to such extent that

their roots actually are situated between those of their neighbors. The writer once operated for an impacted canine, erupting lingually in the upper jaw. The crown was freed by drilling the palate away around its circumference and grasped with forceps. No amount of reasonable traction and manipulation would free the tooth, but the bicuspid showed slight motion.

The buccal wall was then opened by a flap and the canine root was seen to be engaged by the bicuspid. The impacted portion of the canine root

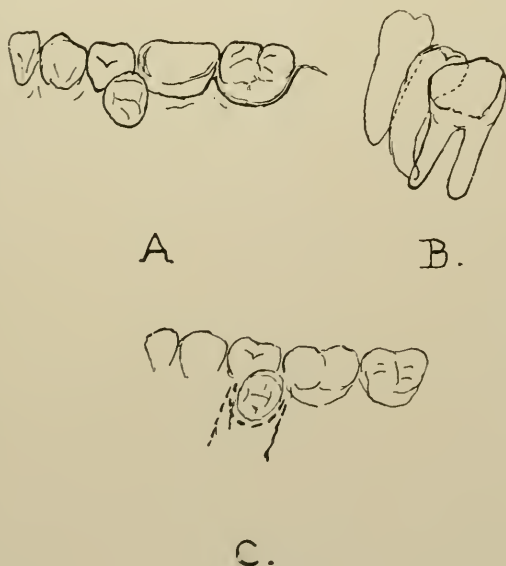


FIG. 76

was cut off with a fissure bur and the tooth was then easily removed from the palate. Thus there was a canal from the facial aspect of the alveolus right through the palate. The canal or wound was carefully washed out, iodoform blown into it, and the facial flap was sutured into position. The palatal opening was packed with gauze. The final result was perfect. Any other method employed would have resulted disastrously as far as the bicuspid was concerned.

Fig. 76A shows a right lower second bicuspid, impacted and erupting lingually. Fig. 76B shows the root impaction. Fig. 76C illustrates the lingual flap. The overlying process or bone was cut away with a bur until the tooth could be luxated; in this case upward, inward, and outward, and then removed from its socket.

XII

THE REMOVAL OF UNERUPTED TEETH

UNERUPTED teeth are those covered by soft or hard tissue or both. If a tooth has perforated the alveolus and is only covered by gum, a fact easily ascertained by the probe, it is a simple matter to

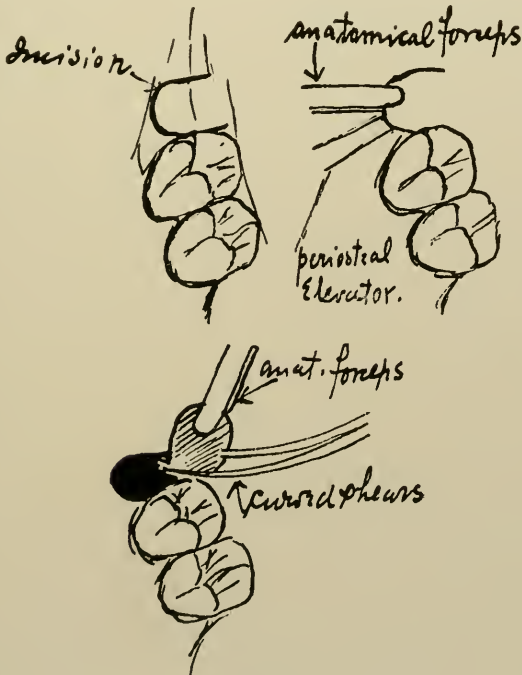


FIG. 77

remove the overlying tissue with knife, anatomical forceps and curved shears. The simplest method to remove such gum tissue is, after painting the part with Tr. Iodine, to make a flap, loosen it with a periosteal elevator, grasp it with anatomical forceps, and then cut off the flap with curved shears or a stroke of the knife. (See Fig. 77.)

To reach a tooth that is covered with bone is more difficult, as the overlying osseous tissue must be removed. The deeper the tooth is buried in bone, the more difficult the operation. A procedure of this kind should never be attempted without a radiograph, which determines the exact position of the tooth, and its relation to surrounding structures. as the inferior dental canal and mental foramen in the mandible and the antrum of Highmore and nasal cavity in the upper jaw. It helps to gauge the severity of the operation, its probable length of time and possible complications. A lower third molar may be lodged so near the inferior border of the mandible that it may prove a much easier operation to make an external incision well under the border of the jaw than to attempt to remove the tooth intrabuccally. This is a rare occurrence, but it may happen. The writer always insists upon an X-ray before operating.

The steps for removal of an unerupted tooth

(buried in bone), which operation can be termed "Odontectomy" (cutting out a tooth), are:

1. Sterilization of field of operation.

- a. Thoroughly brushing teeth and washing the mouth.

- b. Painting the part to be opened with Tr. Iodine.

2. Induction of anæsthesia.

3. Retraction or removal of overlying soft tissues.

4. Removal of bone, covering the tooth with burs, chisels or bone forceps.

5. Removal of tooth.

6. Washing of wound with boric acid solution to remove spiculæ of bone.

7. Packing or closing of wound.

The method of procedure, on the whole, is the same as followed for the removal of impacted teeth, excepting that in freeing a tooth completely embedded in bone more osseous tissue must be removed.

Some teeth are covered by a thin shell of bone, which is easily removed with a bur, as the case shown in Fig. 78, where, after dissecting the gum away, flap fashion, the overlying bone was removed with a fissure bur and a groove cut posterior to the tooth, as indicated by dotted lines. The operator was then able to lift the tooth out of its socket quite readily (Fig. 78).

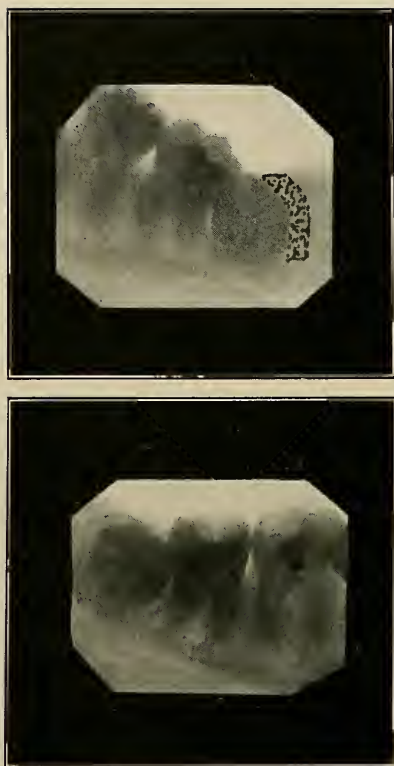


FIG. 78

In other cases the procedure is more complicated. Fig. 79 shows a supernumerary tooth between two upper centrals, one of which was rotated, due to the presence of supernumerary. In this case two incisions, a.b. and c.d., were made;

these joined by a third, b.d., and the flap loosened and retracted. The shaded portion of bone F. was removed with a fine rongeur and burs till the lower portion of the tooth s.t. could be grasped with narrow forceps and removed.

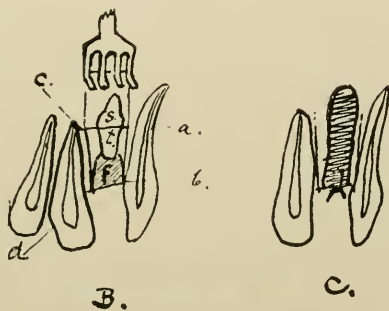


FIG. 79

The wound was washed out with boric acid solution, a little iodoform powder was blown into the cavity, the gum flap returned to its original

position and tacked down with a single silk suture. After five days this was removed, and there was no trace of any operation. The two centrals were not disturbed.

After the cavity will be completely filled with osseous tissue, orthodontic treatment will be resorted to, to bring the rotated central into normal position.

Fig. 80 illustrates one of the most interesting and rare cases the writer has met with in his experience. The patient was a young woman who had suffered from neuralgia and had developed a swollen face, producing trismus. She consulted a dentist, who referred her to a physician, who advised hot poultices and gave sedatives and coal-tar preparations to allay her pain. After suffering ten days and consulting several dentists and physicians, the writer was asked to see the patient, with one of the medical men. The patient at that time was exhausted and near collapse. Her face was swollen, there was trismus, she had a temperature of 103, with a rapid, irregular pulse, 120. Fractured tooth, necrosis of jaw, beginning erysipelas, were the varying diagnoses. There was no fluctuation discernible on the face. She could not open her mouth, but the buccal tissues in the lower molar region were swollen and hard as a brick. The writer, after administering an anæsthetic, made sweeping exploratory inci-

sions along the lower jaw where the swelling was found, but could not reach any pus.

The patient was given opiates and an immediate X-ray demanded, which cleared up the diagnosis. An unerupted lower molar had produced an odontoma. The dark mass occupying the whole molar region and reaching almost from the border up to the gingiva proved a tooth-substance tumor, odontoma. The patient was removed to the hospital, and tooth and tumor removed.

The operation was one of the severest the writer ever had occasion to attend and lasted nearly three hours. One of the dangers attending was the fracture of the mandible, which showed but a very thin strip of healthy bone at the lower border; but good fortune attended the case, and the tumor plus tooth were shelled out without fracturing the jaw. The patient made a complete recovery, and a radiograph taken subsequently showed a gradual regeneration of the jaw. There are very few cases of odontoma on record. If the molar tooth were situated so low in the jaw and there was no other complication present, if it had to be removed, the removal of the tooth could be accomplished by dissecting the cheek away from the mandible and burring and chiseling away the facial wall. In doing this the facial artery would very likely be cut and would have to be ligated, or an external incision below and behind the inferior border of the jaw might accomplish the desired



FIG. 80

end easier. If the incision is located properly, a scar will not be visible.

Fig. 81 shows an unerupted lower permanent canine tooth. The radiograph was taken because the patient still had a perfectly tight temporary canine tooth in situ, and being referred to the writer for an opinion whether or not this "baby tooth" should be removed, particularly as she wanted a bridge put into the space shown. The author advised a radiograph, and the retention of the temporary tooth, as it has its root completely. Were it necessary to ever remove the unerupted tooth, the author would dissect the soft tissue

from the mandible, and “open” the jaw from its facial aspect.

Unerupted teeth demanding operation, in the writer’s experience, occur in frequency as follows:

Most often in—

1. Molars, mostly third and more frequently in the lower than in the upper jaw.

2. Cuspids.

4. Bicuspid.

3. Supernumeraries.

5. Incisors.

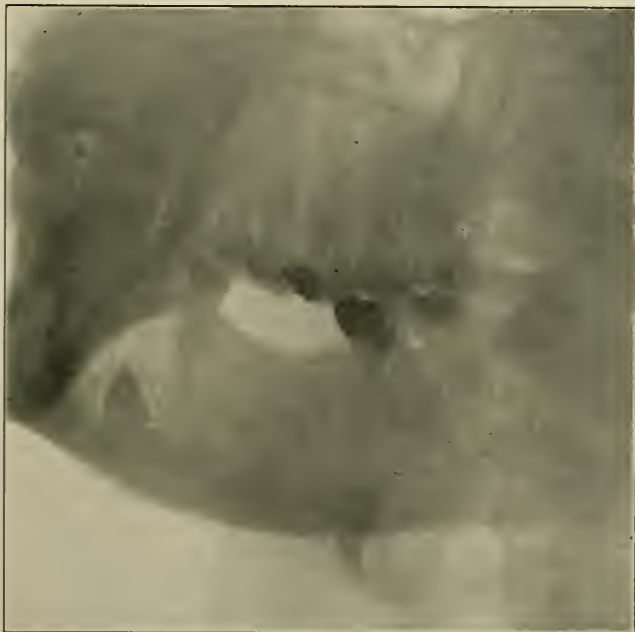


FIG. 81

More often in the upper than the lower jaw.

A good deal more could be written about the removal of unerupted teeth, many more cases could be cited, but it would spell repetition of previously mentioned matter. The most important features are:

1. The correct diagnosis, which can in all cases be made by means of the radiograph.
2. The skilful removal of the tooth.

This means in all cases the dissection of soft tissues and the removal of bone until the tooth is reached. There is no fixed rule how to obtain this end; the writer has attempted, by showing practical cases, to illustrate the general principles.

What must be borne in mind are: Asepsis, and nicety of procedure; by that I mean exactness of execution. In other words, do not hurry; think while you work; speed will come by itself.

Another point to be borne in mind is never to attempt to operate in the dark; do not feel your way along; see what you are doing. Dissect away as much tissue as possible; remove all bone incarcerating the tooth or root to be extracted. An aseptic operation favors healing by primary union, or granulation. Do not spare iodine, the knife or chisel. It is better to cut a little more tissue away and proceed, than to do damage, cause infection, and let the general surgeon do a radical operation for periostitis or osteomyelitis.

XIII

POST EXTRACTIVE TREATMENT

THE treatment of alveolar sockets following extractions is a much neglected subject, and many operators after removing a diseased tooth consider the case ready for dismissal.

This is wrong according to surgical practice; no surgeon would think of creating an open wound and dismiss his patient, trusting to luck that all will remain well.

The treatment of the maxillary alveoli after tooth extraction is that of open wounds, and varies with the type of case presented.

After normal extractions, without complications, the author simply applies Tr. Iodine into the socket and leaves the case alone. It is essential, however, *to inspect the socket the next day* to make certain that no trouble is arising and that there is no tendency for the collection of food in the socket.

The accumulation of food, etc., may lead to infection, and should be guarded against.

The bleeding in the socket usually stops spontaneously, due to clot formation, and clot and alveolus gradually become absorbed.

If drilling or chiseling of bone is necessary, that

a larger wound is created, the part is irrigated with 2 per cent. boric acid or normal saline solution to remove spiculæ of bone, and powdered orthoform, to which a little powdered *plain* novocain is added, is blown into the wound by means of a powder-blower, and a small strip of 5 per cent. iodoform gauze is inserted to prevent food from entering. If the wound is not very deep, the gauze can be omitted after a few days, but irrigation should be continued, first daily, then every other day, and finally about twice a week until the wound is closed.

If the wound is sterile it can be closed at once by silk sutures, which are removed after about five days, in which case the blood filling the cavity clots and becomes organized.

If a chronically abscessed tooth is extracted, it is essential to curette the socket to remove granulations and débris occupying the apical space. The reason for curetting here is due to the fact that when a tooth becomes abscessed nature, in order to protect the surrounding tissues and the organism at large against further infection, throws up a wall of connective tissue to localize the abscess. If the tooth causing the infection is extracted, the original cause is removed, but the pyogenic focus having involved the apical space is not completely extirpated, and the granulations (which contain pyogenic organisms) remaining behind may act

as an independent new pyogenic focus and become the cause, not only of reinfection, but be the starting-point of cystic degeneration. It is, therefore, essential to remove these inflammatory products by the curette to insure a complete cure.

After thorough curettage, the socket is washed out with boric acid, touched with Tr. Iodine, and inspected the next day. It is wise to see the case a third time in forty-eight or seventy-two hours, and if there is no indication of further trouble, the patient is dismissed with instruction to come back if any discomfort is felt.

A little powdered orthoform and novocain blown into the socket will greatly reduce the likelihood of discomfort following.

Sharp edges of bone should always be removed with bone forceps.

POST EXTRACTIVE PAIN

A very annoying sequela of tooth extraction is after-pain. This may be caused by:

1. Fracture of the tooth and part remaining in the alveolus.
2. Alveolitis—i.e., inflammation of the alveolar socket.
3. Remaining of septic material in the socket, as a septic granuloma or abscess.
4. Injecting some irritating substance with local anæsthetic.
5. Septic operation.

The treatment is self-evident. First clear the socket of pieces of root, spiculæ of alveolus or products of suppuration, wash it out carefully with a *warm* non-irritating solution (boric acid or normal saline solution), and make a paste of orthoform, to which a little plain novocain is added, with glycerine, or pack orthoform and novocain powder into the socket. This is best accomplished by placing a tampon into the socket, having the powder scooped up upon a bone spatula, and quickly withdrawing the tampon and then dropping the powder into the socket. The powder is gently pressed down by another tampon, which is withdrawn again, and more powder placed upon the first batch. This is repeated until the socket is filled. The object of the tampon is to prevent the socket from filling with blood, which, if present, makes it difficult to pack the alveolus with powder. The packing of the alveolus with powder usually terminates all discomfort. In the upper jaw the powder can be introduced with the powder-blower. If the powder-blower is used, the operator should not permit the bulb to fill up with air while the pointed end is within the alveolus, as blood is easily drawn into the tip and the apparatus thus clogged.

After using the powder-blower, the tip should be unscrewed, sterilized and dried. In view of the fact that the tip is made of rubber, it is best

sterilized by washing in and blowing alcohol through, then thoroughly drying and replacing upon bulb.

The application of dry heat will often give relief. This can be applied by making a meal-bag and heating in stove, or wrapping a connected electric bulb into a piece of flannel and holding to the face.

Moist heat should not be applied externally, as it favors suppuration. Another useful adjuvant to reduce local hyperæmia is a hot footbath.

The hot footbath must be prescribed as follows:—A tub is partly filled with fairly warm water and the feet immersed. Hotter water is added to raise the temperature of the bath to the greatest degree of tolerance. The feet are kept in this hot water for 5 to 10 minutes, keeping up the degree of heat. This causes a dilatation of the bloodvessels in the lower extremities, reducing the blood pressure in the head and upper part of the body. This accomplished, the feet are thoroughly dried and the patient is put to bed. It is essential not to walk with bare feet and thus cause a chill, as anæmia of the feet and hyperæmia of the upper part of the body will cause the pain to return.

Sometimes we have to resort to internal medication. Phenacetine and aspirine in doses of gr. V each, to be repeated after three hours if necessary, or trigemin, gr. V, or pyramidon, gr. iiss.,

will prove of value. The first essential, however, is the clearing of the socket of all débris.

After a difficult extraction sometimes patients develop an osteitis or periostitis caused by mechanical injury to the bone. The symptoms are pain and marked tenderness to touch, if the periosteum is involved, attended by more or less swelling. The treatment consists of the application of *dry* heat or a wet dressing to the face, or the external application of 5-10 per cent. ichthyol ointment, coupled with the administration of aspirine and phenacetine, until relief is obtained.

POST EXTRACTIVE HEMORRHAGE

The hemorrhage following tooth extraction usually ceases spontaneously. If continuing unduly, it must be checked.

Hemorrhage occurring directly after an injury or operation is designated as *primary*, and the flow of blood occurring some time after traumatism is known as *secondary*. In other words, a second flow of blood after it has once stopped is actually *secondary hemorrhage*.

Hemorrhage can also be classified according to its etiology. Namely, as caused by:

1. Traumatism.
2. Loosening or disintegration of the primary clot.

3. Sloughing of a blood vessel.
4. Lack of coagulative power of the blood.

The first type would constitute primary hemorrhage, the second and third type secondary hemorrhage, and the fourth type may be either primary or secondary in character.

Excessive hemorrhage following tooth extraction is caused by, first, local conditions; second, systemic conditions.

LOCAL CONDITIONS

1. An unusual, large alveolar vessel.
2. By forcing the alveolar plates asunder while extracting, and thus having a "gaping" vessel.
3. Having a fractured root in the socket acting as a wedge and keeping the alveolar plates apart.
4. Injury of larger vessel. Inferior dental artery in the bicuspid region.

The first step is the careful irrigation of the bleeding socket, removing all traces of blood clot which may partially fill the same.

The alveolus is then probed for fractured root-ends or loose pieces of process. These must be removed. The alveolus is then pressed tightly between thumb and index finger to bring the alveolar plates together, in case they were forced apart to any extent by a difficult extraction; this is more apt to occur in the upper jaw than the mandible.

The socket is then tightly plugged with iodoform gauze, upon which pressure is exerted.

It is essential to pack the gauze to the very bottom of the alveolus and pack it tightly in layers. The pressure is best exerted by means of a pair of pliers with cotton wound around them. If the pressure must be continued, a wad of tightly rolled cotton can be placed between the jaws and the patient asked to bite upon the same. If necessary, a bandage can be applied to keep the jaws together. The gauze tampon is removed after two to three days very carefully, and to facilitate its removal a little peroxide of hydrogen is dropped upon the dressing.

If pressure fails to stop bleeding, a clot can be formed by escharization of the vessels with the thermo-or-galvano-cautery.

Styptics and astringents occupy a rather obscure place in the writer's armamentarium, as he has had practically no use for them in over thirteen years of active private, dispensary and hospital practice.

Alum, tannic acid, gallic acid, ferropyrine, adrenalin are all recommended. The writer feels that if *actual, direct* pressure is applied to the bleeding surface, the hemorrhage is *bound* to cease, unless an abnormal condition of the blood, retarding coagulation, is present; such being the case, this has to be corrected.

Text-books tell us that bleeding can be controlled by the internal administration of ergot or tannic acid; this is true in uterine hemorrhages; the author, however, has doubts whether an alveolar hemorrhage can thus be controlled. As an adjuvant to other treatment (pressure) it may have its value, but the writer has never failed to control any hemorrhage if no systemic factor was at the bottom. If internal medication is to be resorted to, the administration of calcium lactate is more certain in action (raising the coagulative power of the blood) than giving styptics internally.

The writer would warn against the use of Monsels' solution, as the clot formed by sesquichloride of iron comes away easily and bleeding is started again.

A patient suffering from severe bleeding, after having the socket packed, and this is *always the first consideration*, should be placed at perfect rest, *sitting* up in a comfortable chair, in a cool room. Cold applications to the jaw wherever the bleeding takes place have a tendency to constrict the blood vessels.

SYSTEMIC CONDITIONS

General systemic conditions of interest to the dentist in the treatment of post extractive hemorrhage are mainly: Anæmia and hemophilia.

If the operator is careful and closely observes his patient before operating, he will frequently note the pallid appearance of his patient, though, of course, not all anæmics look pale. However, the operator should note all little details about his patient and make good use of his findings *before* he meets with alarming symptoms. The important fact to bear in mind is that just as the amount of blood in an organism is reduced, so the coagulability of the remaining liquid is lessened; therefore, an anæmic individual should be treated with care. If a large number of teeth are to be extracted and the patient appears very anæmic, it is better to consult the physician, or if that is not practicable, why, make an approximate hemoglobin estimate with Talquist hemoglobin scale. It will give a fairly accurate idea of the hemoglobin status of the patient, and if it is low (60 or less) it is safer to consult with the medical adviser.

It is better to err on the safe side a good many times than to fail to recognize one case which will cause trouble. The operator may not have any trouble but once in a lifetime; the careful operator should, however, *never* meet with an accident which is avoidable, and be *always* on the lookout.

If the teeth are the cause of infection, of course, the septic focus must be removed at all times, but

precautions should be taken to avoid any untoward effects.

HEMOPHILIA

Is a condition of the blood wherein there is present a chemical disturbance which interferes with coagulation. The careful operator should always bear in mind the possibility of his patient being a hemophiliac and question him accordingly. If the history of the patient brings out that he suffers from such disturbance, the writer prescribes calcium lactate, as well as the ingestion of albumen (in the shape of as many raw eggs as the patient is able to take, six to eight a day) for about thirty hours prior to extracting. This prophylactic treatment has controlled all excessive hemorrhage in the six cases which the writer has seen.

Case I: Patient J. D., age thirty, pale-looking, delicate young woman, unmarried. Distinct history of hemophilia, bleeds very profusely at the slightest injury, menstruation very copious, lasts about a week, always in delicate health. Had a molar tooth extracted in the morning and bled quite profusely. Dentist told her to rinse mouth with cold water. Alveolar hemorrhage finally stopped late in the afternoon and patient went out that evening. About ten o'clock bleeding started again. Patient returned home and tried several home remedies; these failing, a physician was summoned, who packed the alveolar socket with

adrenalin gauze. This did not have the desired effect, the bleeding continued, and the patient began to show signs of weakness, finally fainting. The writer was called in consultation at two A. M. The patient looked very, very pale, and was too weak to stand. Her pulse was rapid and very thin. The writer first cleared out the socket, broke up the alveolar septum, curetted out pieces of clot, and then packed the socket very tightly with iodiform gauze, placed a roll of cotton between the jaws and applied a bandage.

The patient was put to bed and given morphine and atropine hypodermically, also twenty grains of calcium lactate were administered. Raw eggs in milk were ordered every three hours. The calcium lactate was ordered in twenty-grain doses every four hours for two days; also the ingestion of lots of water. Patient remained in bed ten days. A tonic containing iron and strychnine was given, and plenty of nourishing food—milk, broth, eggs. There was a slight recurrence of hemorrhage on the fifth day, when the packing was removed. Calcium lactate was administered again for thirty-six hours.

A year later the same patient had to have another tooth removed. She consulted the writer. She was given calcium lactate and egg albumen for thirty hours prior to extraction, and there *was no abnormal* hemorrhage.

The other cases which the writer saw were cases sent to him as "hemophiliacs" for extraction. They all received calcium lactate in fifteen-grain doses every four hours until five or six doses were taken, also albumen in the shape of raw eggs, and they all did well.

The following case is of interest, showing the value of treatment before extraction in a negative way:

Mrs. E. A., age 33, married, hemophiliac, was referred by her dentist for the extraction of two small roots. The patient requested to have her physician present. The physician, upon arriving at the writer's office, sent the patient from the room and told the writer: "Now, Doctor, I do not believe in this calcium treatment; there will be no trouble in this case at all; you just extract these roots." The writer called the physician's attention to the fact that the patient had had a great deal of trouble only a year previous after having a tooth extracted by another specialist. The physician insisted upon having the roots out without preliminary treatment, taking, as family physician, all responsibilities upon himself. Under those circumstances, the writer yielded and extracted the roots. Three days later the writer was summoned late at night by the physician "to do something to stop the bleeding." The hemorrhage was finally stopped after most strenuous

treatment, using the thermo-cautery three times and giving several injections of horse serum. The patient was in bed for three weeks, until she was strong enough to leave the city for a stay in the country.

The damage in hemophiliacs should be avoided by treatment before the extracting.

The treatment if "a case is a bleeder" consists, first, in "cleaning up" the bleeding alveolus, packing it and administering:

Calcium lactate and egg albumen, as indicated above.

Rest in bed and the general improvement and building up of the system.

The injection of horse or human serum to raise the coagulability of the blood.

If human or plain horse serum is not available, antidiphtheretic serum from any Board of Health Station will answer the purpose.

The local application of horse serum upon gauze right into the bleeding socket has also proven valuable.

If a great deal of blood has been lost, the intravenous injection of normal saline or Ringers' solution is indicated.

Blood transfusion may have to be resorted to. Cases of this type are distinctly hospital cases, as they need constant watching and treatment which cannot be given at home.

XIV

THE TREATMENT OF COMPLICATIONS ATTENDING TOOTH EXTRACTION

TOOTH extractions are sometimes attended by accidents and complications, the treatment of which shall be considered in this chapter.

1. *The Luxation of Adjoining Teeth*

The accidentally loosened tooth is ligated to its neighbors by a silk or wire ligature. The writer preferably employs Angle's regulating wire, as a metallic thread is not affected by the buccal secretions and food as silk or cotton.

The best ligature for this purpose is made by including the luxated tooth and those teeth which are to support it in a wire loop and twist it fairly tight. Then pass another wire between each interproximal space faciolingually under the first loop and bring it out linguo-facially over the same. This interproximal loop is drawn tight. Thus a small loop is passed under and over the ligature, holding all the teeth between each interproximal space. After all interproximal spaces are wired, the original or large loop is drawn tight. The twisted extended portions are doubled up into the

interproximal spaces, so that the lips are not traumatized. They must not extend too far lingually, or they will injure the tongue. This is practically a Hammond splint. A few days' immobilization



FIG. 82

Showing the Manner of Tying Wire Splint

will usually restore these teeth to normal health, unless the pulp is affected, and then the treatment, of course, is devitalization.

2. *Accidentally Extracted Teeth*

can sometimes be implanted. If a tooth be removed accidentally, it is washed in lukewarm sterile saline solution, grasped with sterile gauze, opened, pulp removed, pulp chamber and root

canal thoroughly cleansed and filled, the tooth filled and again washed in saline and reintroduced into its socket and ligated to its adjoining fellows. It is evident the tooth has to be handled carefully, and strict asepsis must be observed. It is essential to avoid injury to the pericementum, so that the reimplantation be a physiologic implantation. If the periodontal membrane is destroyed, the reimplantation will be a mechanical implantation, just as a porcelain root would be. A physiologic implantation has a better chance of permanency, as Kauffer, of New York, has shown.

The writer has seen a few (three or four) such reimplanted teeth, having given satisfactory service for several years; however, he is very skeptical as to the final outcome. It is a risky thing to promise a patient a good result with certainty. It is worth trying, if all steps are carried out under absolute asepsis.

3. *Fracture of Adjoining Teeth*

The treatment is, of course, the restoration of the lost structure by filling, inlay or artificial crown, according to the amount of tissue lost.

The writer suggests to wait a few days until a restoration by filling or inlay is attempted to have an opportunity to learn whether or not the pulp has been affected by traumatic shock. It is awk-

ward to perform a restoration and then be forced to open into the tooth a little later. Of course, we have to bear in mind that a tooth may not show signs of devitalization for a long time, sometimes not for months or years.

4. *Fracture of Alveolus*

If there obtains a comminuted fracture of the process and there are small loose pieces discernible, these should be removed; otherwise the alveolus is gently pressed "into place," i.e., restored to its original position and left alone. In a few days union will usually occur.

5. *Fracture of the Jaw*

A very rare complication, unless there exists necrosis, so that only a narrow strip of healthy bone remains. The treatment of fractures is so well known that I shall not enter into its discussion. A radiograph, however, should be taken in all cases of fractures of the teeth, alveoli or jaw, as the X-ray will bring out complications which may not be suspected.

6. *Opening of the Antrum of Highmore*

The accidental opening of the Antrum of Highmore may occur during the extraction of upper teeth. The treatment of this mishap varies with different attending conditions. If the root of the

extracted tooth entered the maxillary sinus and there is no sinus disease present, it is best to either suture the opening directly with silk or silk wormgut, without probing or washing, as infection may be carried into the sinus, or to place a piece of iodoform gauze *against, not into*, the opening, and hold this in place by passing a figure-of-eight wire ligature around the adjoining teeth.

The symptoms of breaking into the antrum are: First, appearance of blood through the naris on the same side; second, forcing air through the nose into the mouth; third, nasal twang of speech.

The first symptom may be absent if adrenalin has been injected; the last symptom is rarely present. The second sign, however, the ability to force air into the mouth through the nose, the nostrils being shut with the fingers, is the most reliable sign attending this accident.

It is a wise precaution to have the patient try this if one is in doubt. Of course, we have to bear in mind the possibility of infecting the antrum if the patient is suffering from "a cold," as a large percentage of cases of antrum disease is caused by nasal infection.

7. Forcing of a Tooth or Root into the Antrum

If a tooth is forced into the maxillary sinus, this is removed more easily than a root, as the opening created is larger and a tooth can be grasped

with anatomical forceps. A small root slipping into the antrum through a small opening offers more difficulty for its removal. The proper procedure is to make an opening large enough to remove it, as a maxillary sinusitis will most likely result if the root is left in situ. A radiograph will facilitate the localization of the root, if it cannot be reached readily. The opening should be made by preparing a mucoperiosteal flap, *i.e.*, to dissect mucous membrane and periosteum away from the bone, cut away sufficient bone to be able to remove the root, and then suture the mucoperiosteal flap to close the opening. If the antrum is in a healthy state, nothing should be introduced into the same but normal saline or 2 per cent. boric acid solution, then the cavity closed.

If while extracting the operator enters a cavity, he should not take it for granted that he is "in the antrum," but bear in mind the possibility of the presence of a cyst. The differential diagnosis depends upon the following points:

1. A cyst contains liquid or semi-liquid material. It is a good plan to wash out the cavity with sterile saline and note the appearance of the liquid returned.

2. A cyst, unless it has involved the antrum, will not permit passage of air from the nose into the antrum and thence into the mouth.

3. If there exists a normal ostium maxillare and

liquid is forced into the antrum, the same will flow from the nose.

4. The radiograph.

If the cavity entered proves to be a cyst, this, of course, must be treated accordingly.

8. *Fracture of the Tooth While Extracting*

The question whether or not a tooth which fractures while being extracted should be permitted to remain has been brought up from time to time, and well-known specialists differ in their final opinion.

Primarily the writer would say that a broken-off root should always be removed; on the other hand, he would not deem it wise to subject a patient, who is already suffering from shock, to a long searching operation, which in the end is not completed.

If a root fractures, the writer proceeds as follows: Every reasonable attempt is made to remove it by means of fine forceps and elevators.

These means may prove fatal for two reasons:

1. Incessant hemorrhage.

2. The fractured piece may be so small that it cannot be reached, i.e., the alveolar socket is so deep that the root cannot be grasped or encroached upon.

If the hemorrhage interferes with the operation, the writer packs the socket with iodoform

gauze and dismisses the patient. At the next visit the patient is given bromural, gr. x, and the site injected with novocain and suprarenin, the tampon carefully removed and the root taken out by cutting away the overlying tissue with knife and chisel or bur, doing a flap operation.

If the root escapes all attempts of removal, the patient is radiographed to ascertain its exact position, its shape (sometimes crooks or hypercementosis incarcerate it) and the surrounding structures, for one has to consider the inferior dental canal, and mental foramen in the mandible, and the antrum and nasal cavity in the upper jaw. After the root is located it is removed by the open-flap operation.

9. *Trismus (Locked Jaw)*

Swelling about the face producing "locked" jaw may prove a difficult complication of tooth extraction.

The infiltration of the muscles of mastication caused by abscessed or impacted lower molars particularly engages our attention. This infiltration produces that swelling "hard as a board," locking the jaws completely, preventing even the introduction of a thin cardboard between the teeth; or the patient may be able to open the jaws more or less, but not sufficiently to apply forceps to the guilty tooth. The amount of trismus de-

pend upon the muscles which are infiltrated and upon the stage of inflammation present. The writer divides locked jaw into three types:

Locked Jaw of the First Degree

Cases wherein the patient is able to open the mouth sufficiently so that the tooth to be extracted can be reached with little stretching.

Locked Jaw of the Second Degree

Cases wherein a finger can be introduced between the anterior teeth.

Locked Jaw of the Third Degree

Cases wherein the jaws are closed completely.

The successful termination of these cases try the utmost judgment of the operator. The cardinal questions to ask are:

Is the patient suffering from pain and direct infection that an immediate extraction is imperative?

Is pus present and can pus be reached?

The first degree of locked jaw is overcome by administering an anæsthetic; introducing a Denhart gag and gently forcing the jaws apart sufficiently to grasp the diseased tooth with forceps.

The second degree gives a little more concern. The injudicious stretching of infiltrated muscle may result in injury of this structure with subcutaneous hemorrhage. Very undesirable compli-

cations, causing permanent damage, may result (stretching of ligament, tearing of muscles). There is danger of producing *severe* shock if a muscle is stretched forcibly.

In these cases it is advisable to administer sedatives—bromural, 0.6 (gr. X) or opiates, morphine sulphate, 0.0015 (gr. $\frac{1}{4}$)—to reduce shock and sensibility, and then applying hot applications to the swelling for five minutes, then introducing an oval screw between the teeth and gradually produce relaxation of the infiltrated muscles. The stretching must be done gradually, and it is surprising what can be accomplished with a little patience.

The opening of the jaws may require from ten minutes to an hour.

After the jaws have been opened sufficiently, the tooth giving trouble is extracted.

The most difficult cases to treat are, of course, those of the third degree. The method of procedure is the same as outlined for treatment of the second degree. The patient is given an opiate and the teeth pried apart gradually with any fine instrument, so as to enable the operator to introduce the small end of the screw gag. This instrument is then very slowly turned to gradually force the jaws apart. In some cases it is impossible to get sufficient relaxation to extract, but we can open the jaws far enough to be able to palpate the

swelling intrabuccally and incise where pus is felt or suspected. After drainage has been established, the swelling will begin to go down. The treatment after incision consists in:

1. The administration of a laxative.
2. The local application of wet dressings of either Thiersch's solution, Liq. Alumini Acetatis, or a saturated solution of Epsom salts, diluted with four parts of water.

These cold applications can be made for one hour at a time, three times a day, or a wet dressing can be put on and kept there in situ by a bandage. A mouth-wash is to be used frequently to reduce oral sepsis.

In conclusion, the author again emphasizes the fact that tooth extractions are surgical procedures and must be carried out according to surgical principles. Careful examination and deliberation are essential before extracting, post extractive inspection and treatment are required subsequently.

Tooth extractions are divided into:

1. Normal extractions.
2. Root extractions, $\left\{ \begin{array}{l} \text{Normal,} \\ \text{Surgical.} \end{array} \right.$
3. Removal of impacted teeth.
4. Removal of unerupted teeth.

Surgical root extractions, as well as the removal of impacted and unerupted teeth, are best

carried out by the preparation of a tissue flap and the free removal of overlying bone tissue.

The technique in all cases is:

1. Sterilization.
2. Induction of anæsthesia.
3. Preparation of soft tissue flap.
4. Retraction of flap.
5. Removal of overlying bone tissue.
6. Removal of root or tooth.
7. Removal of all granulations or broken-down tissue.
8. Irrigation of wound with non-irritating solution.
9. Packing or closing up of wound.
10. Subsequent inspection or repacking or irrigation of wound, as case demands.

PART TWO

LOCAL ANÆSTHESIA OF THE MAXILLÆ

I

ANÆSTHESIA

General—Local—Conductive—Regional

ANÆSTHESIA is the loss of sensation produced by the action of agents known as anæsthetics.

General anæsthesia is induced by the introduction of such agents into the circulation which, acting upon certain cerebral centers, produce unconsciousness accompanied by complete loss of sensation.

General anæsthetics are introduced by inhalation through the lungs and by intravenous or rectal infusion. They are absorbed by the blood, and thus carried to the brain.

Local anæsthesia is the regional loss of sensation produced by the action of certain agents upon sensory nerves. Agents producing local loss of sensation are known as local anæsthetics. Local anæsthesia has displaced general anæsthesia to a large extent in dental and oral operations.

Local anæsthesia can be produced by physical means, as cold and pressure, and by the use of drugs, as cocaine, eucaine, alypine, novocain, etc.

Physical agents shall not be considered, but the

writer shall confine himself strictly to the production of local anæsthesia by the use of drugs.

Local anæsthesia can be produced by three methods: Direct application, infiltration and "nerve blocking" (conductive anæsthesia).

Anæsthesia by direct application is obtained by painting the part with a solution of the anæsthetic or the application of a tampon dipped into such solution. For example, a tampon dipped into the anæsthetic and inserted into the nares will cause anæsthesia in the anterior part of the upper jaw.

Infiltration anæsthesia is produced by the hypodermic injection of the anæsthetic into the field of operation.

Conductive anæsthesia is obtained by injecting the anæsthetic into or about a nerve trunk, producing anæsthesia in the whole area of distribution of that particular nerve; prohibiting afferent impulses traveling along this nerve and its branches, and thus preventing their reaching the brain.

The following example will illustrate both methods. Suppose a lower six-year molar is to be extracted:

Infiltration anæsthesia would be produced by injecting the buccal and lingual aspects of the alveolar process, which would cause a loss of sensation in and about that tooth.

Conductive anæsthesia would be induced by in-

jecting the mandibular nerve at the inferior dental foramen, which would produce anæsthesia in that half of the mandible up to the median line, anæsthetizing all teeth in that half of the lower jaw, the anæsthesia lasting for an hour or longer.

II

SOLUTION FOR LOCAL ANÆSTHESIA

IN VIEW of the fact that local anæsthesia is produced by hypodermic or hypomucous injection of the anæsthetic agent in solution, and this solution is brought in direct or indirect contact with nerve and other tissues, it is of great importance that the agent, as well as its solvent medium, be tolerated by the tissues without injury to the cellular elements.

What are the requisites demanded of a solution employed to produce local anæsthesia?

1. It must be non-irritating to the tissues.
2. It must be readily absorbable.
3. It should be as devoid of toxic effects as possible.

In studying the effects of agents employed to produce regional anæsthesia we have to consider:

1. The solution used as a solvent for the anæsthetic agent and its effects upon the tissues.
2. The physiologic effects of the anæsthetic upon the sensory nerves.
3. The physiologic effects of the anæsthetic upon the organism as a whole, or, in other words, its degree of toxicity.

The Solvent Medium

If sterile water is injected hypodermically, a wheal is formed followed by osmotic action between the injected liquid and the contents of the tissue cells.

The tissue cells by endosmosis take up water, swell up and at the same time, by exosmosis, they give up some of their salt elements. Water as H_2O alone does not exist in the body, water always being the solvent or suspending medium of organic or inorganic substances.

The swelling of the tissues produces a certain amount of anæsthesia, due to pressure upon the terminal nerves, on one hand; and on the other, the sensibility of the part is also reduced by the physical, or maybe even chemical, changes taking place in the nerve cells, due to the injection. The resulting anæsthesia is always preceded by pain, is of short duration, very unsatisfactory and attended by disturbance, or rather irritation, of the tissue cells, which frequently leads to necrosis.

If a little salt (sodium chloride) is added to the water, and this solution is injected, the pain is somewhat less and will decrease, as the salt content of the solution is increased until isotonicity to the blood is reached.

Then there is absolutely no discomfort felt but no anæsthesia. If the salt is increased beyond 0.9 per cent., pain reappears, anæsthesia follows

and the tissue cells suffer. These phenomena increase proportionately as more salt is added. It is impossible to bear the pain attending an injection of a saline solution containing more than 10 per cent. sodium chloride.

The foregoing (experiments made by Braun and Heinze) shows that saline solutions for hypodermic injections to be non-irritating must contain a definite amount of salt. The concentration of this solution must correspond to the concentration of the blood. In other words, it must be isotonic. The object of the solution is simply to act as a diluent and carrier for the anæsthetic. The saline solution does not produce, in fact should not produce, anæsthesia; the pain abolisher is the anæsthetic, and the saline solution is simply the means of transporting the drug into the nerve.

A solution of sodium chloride 0.6 per cent-0.9 per cent. in water is designated as physiologic or normal salt solution.

If the injected solution is hypotonic (less concentrated than the blood plasma), the cellular elements will take up water from the solution and swell up; in the case of red blood cells actual hemolysis may result.

If the injected solution is hypertonic (more concentrated than the blood plasma), the tissue and blood cells will give up part of their aqueous contents and shrink. If the solution is isotonic to the

blood, then an even absorption of the injected liquid takes place. Normal salt solution is such an agent.

Prof. Guido Fischer of late advocates the use of Ringer's solution in lieu of normal saline solution as the solvent for local anæsthetics. Ringer's solution contains, besides sodium chloride, calcium and potassium chloride. It was found that the tissues take up the mixed chlorides even better than sodium chloride alone, as they make a more isotonic solution to blood plasma than normal salt solution.

The importance of a solvent medium isotonic to the blood, containing no ingredients which will interfere with normal absorption or irritate the tissue cells, cannot be emphasized sufficiently, and any operator who uses proprietary or secret nostrums for hypodermic injections, the composition of which he is not absolutely acquainted with, cannot be criticized severely enough.

It is more accurate, cleaner, and therefore safer, to prepare the solutions for local anæsthetics in the office than to purchase solutions in stock bottles. A very convenient method is the purchasing of anæsthetic solutions in ampules; one must be certain, however, that they are permanently sterile. G. Fischer bought some ampules in open market and found that some showed the presence of cocci after a few months.

If the ampules are sterile, the end is merely

broken off, the needle inserted and the contents drawn into the syringe; it does away with keeping of stock saline or Ringer's solutions, and the boiling of the tablet. The writer is still preparing his own anæsthetic solution, as described herein.

The writer would hold any operator directly responsible for unpleasant after-effects from hypodermic injections if the operator does not know the exact ingredients of a solution employed. It is the writer's opinion that carbolic acid, potassium iodide, iodine, baptisia, hamamelis and the hundred and one other drugs as ingredients in local anæsthetics placed upon the market have absolutely no place in such preparations, and they can only exist and enjoy a sale due to the ignorance of the profession at large.

The important feature about a local anæsthetic is not the anæsthesia alone, which is obtained with many preparations on the market, but a very important factor is that the tissues, after anæsthesia has passed off, be left unharmed. This state can only be obtained by a non-irritating isotonic solution.

Postanæsthetic pain, œdema, gangrene, necrosis, embolism, ecchymosis and other undesirable and harmful results after local anæsthesia are caused by lack of asepsis, for which the operator is responsible, or the injection of media which cause the death of tissue cells.

The action of the anæsthetic should simply be

a temporary inhibition of impulse transmission *without destroying* tissue cells. It, therefore, is apparent that the proper solvent medium for producing local anæsthesia is important and, in the light of modern science, not a question of choice—only normal saline or Ringer's solution can be considered.

Preparation of the Solvent Medium

Chemically pure sodium chloride tablets for making normal salt solution can be purchased from any of the well-known drug houses. These tablets, in well-corked colored bottles, will keep a long time. One tablet, according to weight, is dissolved in the proper amount of *previously boiled sterile water* (this does not mean tap-water which has been boiled, but distilled water which has been sterilized), so that a 0.6 per cent. sodium chloride solution is obtained. If a tablet weighs 2 grm. (30.9 grs.), three tablets dissolved in one litre will give the proper solution. Ringer solution tablets (Farbwerke, Hoechst Co.), dissolved according to directions (one tablet in 10 ccm. of water), will give Ringer's solution.

These solutions can be kept in alkali-free stock bottles, but they must be well stoppered. The author uses a ground-glass stoppered bottle, over which a ground-glass cap is placed (Fig. 84). Three or four ounces (90-120 ccm.) are prepared, which lasts for several days. The least cloudiness of the solution makes it unfit for use.

III

THE ARMAMENTARIUM

The Syringe

THE syringe should be a good all-metal and glass syringe, holding 40 min., or one having a tight-fitting, interchangeable asbestos plunger. A syringe with leather washers or plungers is not fit for this work, as the leather is affected by boiling and alcohol.

The author uses a Freienstein syringe made of glass and metal, excepting the plunger, which is a pad of asbestos. All parts are interchangeable (Fig. 83). Prof. Guido Fischer employs an instrument of the same make, devised by himself, made entirely of metal and glass, with a revolving hand-rest.

The writer finds Fischer's syringe a little too heavy; but in the end it makes little difference which type of syringe is employed, as long as it is capable of sterilization and none of its parts injured by alcohol.

The syringes are kept in a jar, which contains a metal stand holding several syringes (Fig. 84). The jar is filled with a mixture of 70 per cent. alcohol and 30 per cent. glycerine, and the syringes re-



FIG. 83

The Instrument Towards the Extreme Left Is Prof. Fischer's Syringe. The One in the Center Is the One Most Frequently Used by the Author. The One on the Right is Prof. Williger's Mandibular Syringe; This Only Holds 1 ccm.

main in the mixture when not in use. When they are to be used they are removed from the alcohol mixture and washed in *sterile water*, and sterile water is passed in and out of the barrel, repeatedly, so as to remove *every trace* of glycerine and alcohol before the anaesthetic is drawn into the syringe.

Needles

The author uses two types of steel needles: for mandibular injections, the No. 1 (0.90 mm. in diameter), 40 mm. long, and for all other injections the No. 17 (0.47 mm. in diameter), 42 mm. long. All needles fit into a hub, which is screwed upon the syringe and drawn tight with a wrench.

The needles are made of seamless tube; the mounting consists of a soft metal head and a thin but strong hard metal casing. The soft metal forms an absolutely tight joint with the end of the syringe, and the hard metal prevents the needle from sticking in the hub, and also prevents the soft metal from becoming distorted.

These needles offer decided advantages over the old-fashioned threaded needle, which is screwed directly onto the syringe. They are cleaner and form a closer joint with the syringe, so there is practically no leakage. The author uses the steel needles with satisfactory results. The Platinum-Iridium needle offers the advantage that, once mounted upon the syringe, it need not be removed, as it is sterilized by burning it in the alcohol flame. The steel needle and hub, of course, are removed after being used once, and changed for a new one. Some men advocate the discarding of the steel needle after using it once; the author, who received part of his training in Prof. Williger's Clinic, still adheres to the method used there. Williger

does not discard his needles after using them, but sterilizes them and employs them again. However, each needle is carefully inspected before being sterilized and the slightest defect condemns it to the scrap-pail. The author would sound a note of warning to exercise great care in the use of steel needles: to *carefully inspect* them *daily* before sterilizing, so as to note any defect and discard them at once if a flaw is discovered.

A rusty needle means trouble, and a broken needle a lot of anxiety, for, as a rule, only a surgeon can remove it.

If a needle fractures at the hub, there is a chance to grasp it with anatomical forceps and withdraw it, but if it breaks distal to the hub within the tissues, its removal can only be done by a surgeon.

The possibility of fracture caused a good many operators to use Platinum-Iridium needles. These, however, after heating repeatedly, get quite soft and make the palpation of the bone (in mandibular injections) rather difficult.

There is less chance for needles to break in other injections than in mandibular anæsthesia.

The needles are washed out after using, the wire is drawn through them, they are then boiled and then placed in a closed vessel containing the alcohol and glycerine mixture, or in pure lysol. If they are kept in lysol, they have to be washed thoroughly in sterile water, to remove *all traces of*

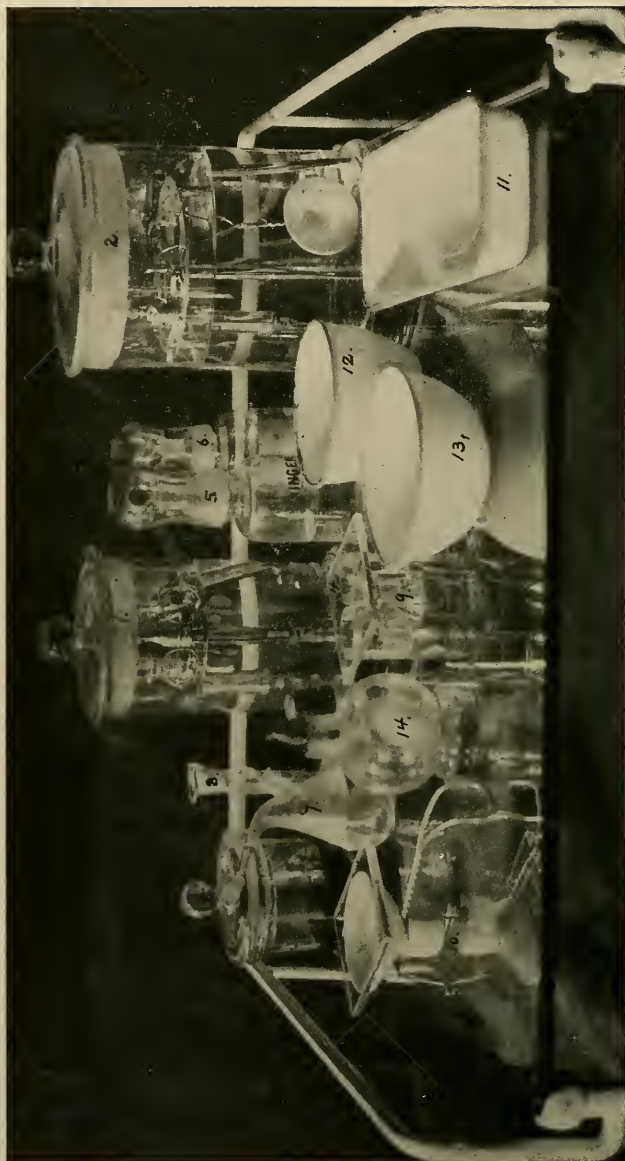


FIG. 84

lysol, before attaching to the syringe. If they are kept in the glycerine-alcohol mixture, they are, of course, also washed in *sterile* water to remove every vestige of alcohol and glycerine. The chucks or hubs are treated just the same as the needles.

Fig. 84 shows the author's arrangement of his local anæsthesia armamentarium.

Nos. 1. and 2. are glass jars, containing a metal stand holding the syringes. (Jar 2. also holds a novocain crucible.) Each jar is partially filled with alcohol-glycerine.

No. 3. is a jar for needles containing *lysol*.

Nos. 5. and 6. are glass-stoppered, glass-capped bottles containing Ringer's solution.

No. 7. is another bottle for Ringer's solution, devised by Dr. Riethmuller, of Philadelphia.

No. 8. is a minim graduate; when not in use, it is stopped with absorbent cotton.

No. 9. are three medicine glasses, each of different color, to hold novocain powder or other drugs.

No. 10. is a porcelain crucible for boiling Ringer's solution and preparing novocain for injection.

Nos. 11., 12. and 13. are enamel dishes holding sterile water. No. 11. is to wash off the syringe when it is removed from the jar; No. 12. is to wash off needles, and No. 13. is to wash out the syringe.

No. 14., alcohol lamp for boiling solutions and to burn off platinum-iridium needle.

No. 4. are glass slabs to cover the porcelain crucible (10.) and the medicine blocks (9.), so that no dust contaminates their contents.

The glass table is used for nothing else but the preparation of anæsthetic solutions.

Steps of Injection

1. Boil Ringer's solution in crucible.
2. Drop novocain-suprarenin tablets in crucible and bring to boiling point to dissolve tablets; place glass cover on crucible.
3. Remove syringe from jar, wash outside in *sterile* water and dry in *sterile* towel; do not remove cap.
4. Remove needle and hub from jar with pliers, and wash with sterile water in special dish.
5. Remove cap from syringe, attach needle and hub with pliers and wrench.
6. Pass sterile water in and out of syringe, a third special dish.
7. Fill syringe with anæsthetic.
8. Iodize mucous membrane.
9. Inject anæsthetic; wipe needle with sterile cotton.
10. Remove needle and hub, wash in sterile water, replace wire into needle, then sterilize by boiling.

11. Wash syringe by passing fresh sterile water in and out, attach cap, wash outside of syringe, dry.

12. Replace into jar.

If Platinum-Iridium Needle Is Used

1. Boil Ringer's solution in crucible.

2. Drop novocain-suprarenin tablets into crucible and bring to boiling point to dissolve tablets; place glass cover on crucible.

3. Remove syringe from jar, wash outside in sterile water and dry in sterile towel.

4. Wash out syringes in sterile water.

5. Sterilize needle in alcohol flame.

6. Fill syringe with anæsthetic.

7. Burn off needle.

8. Iodize mucous membrane.

9. Inject anæsthetic, wipe needle with sterile cotton.

10. Burn off needle.

11. Wash out syringe, dry outside.

12. Replace syringe and needle into jar.

IV

COCAINE

LOCAL anæsthesia only became an established fact after the recognition of cocaine as an anæsthetic agent. Prior to this time compression of nerve trunks, the application of cold by freezing mixtures and the spraying of ether and other volatile substances were practised, but all this with indifferent and unsatisfactory results.

History

Pizarro, when invading Peru in 1532, discovered that the inhabitants of that country cultivated the Coca plant (*Erythroxyton Coca*) and chewed the leaves to appease hunger and to overcome fatigue.

Messengers running long distances carried a supply of coca leaves for artificial stimulation and cutting down rations and sleep. It was also known that the excessive use of the plant proved very harmful. The Spanish government prohibited the general cultivation of the coca plant for some time; later, however, permitted its growing, but levied a tax upon its production. By this taxation the State of Bolivia during 1850, according to Wendell, netted a revenue of three million dollars.

The first to bring a larger quantity of coca leaves to Europe was Scherzer. Part of this sup-

ply was given to Wöhler in Göttingen, Germany, whose scholars Niemann and Lossen were the first to produce the alkaloid cocaine. Later cocaine was produced synthetically by Merck, Einhorn, Liebermann and others.

Cocaine, $C_{17}H_{21}NO_4$, is an alkaloid obtained from the leaves of *Erythroxylon Coca*; it occurs in colorless, quadrilateral, or hexagonal crystals, sparingly soluble in water (1:700), very soluble in alcohol, ether and chloroform; it has a bitter taste, and when placed upon the tongue causes a local sensation of numbness. With acids it forms salts. The one chiefly used is cocaine hydrochlorate, $C_{17}H_{24}NO_4H$.

The history of cocaine as an anæsthetic dates back as far as 1855, when Garmecke noted that a certain amount of lingual anæsthesia is induced by chewing the coca leaves. In 1857 Percy found a more marked anæsthesia by placing *Erythroxylon* (another product of the plant) upon the tongue, and in 1860 Niemann found the same action, only more marked, produced by cocaine.

Denarle, Schroff (1862), Morens y Maiz (1868), Von Anrep (1879), conducted experiments with the newly found substance, and the last named was the first to inject cocaine subcutaneously into his arm, and obtained local anæsthesia by the hypodermic method.

Borderau and Coupard (1880) found that the

instillation of a cocaine solution into the eyes of animals abolished ocular reflexes, and Fauvel, Saglia and others employed cocaine in the treatment of painful affections of the larynx and pharynx.

However, cocaine was not universally acknowledged and accepted as an anæsthetic agent until Karl Koller, of Vienna (now of New York), in 1884, before the Ophthalmological Congress at Heidelberg, demonstrated that the instillation of a 2 per cent. solution of cocaine into the eye permitted the performance of ophthalmological operations without pain.

Physicians all over the world began to use it, and scientists took up the study of this new drug. The report of Koller was soon corroborated by Agnew, Moore, Minor, Knapp, Gräfe and others, and the cocainization of the eye and mucous membrane became universal. Cocaine soon established itself in laryngology and rhinology, and was also used in genito-urinary practice. Soon surgery, as well as dentistry, made use of the wonderful properties of this drug. In 1885 Corning reported that if the circulation be cut off in the part to be anæsthetized, the action of the drug became intensified, and anæsthesia is obtained with much weaker solutions, thus reducing the toxic effects. To produce anæmia in the part, he employed Esmarch bandages. This discovery was the forerunner of

our present dry method of producing local anaesthesia coupled with anaemia (anaesthetic plus adrenalin). Corning and Goldscheider demonstrated that the conductivity of impulses along the nerve is inhibited by the injection of cocaine, and this in turn is the forerunner of conductive anaesthesia.

How rapidly these findings were utilized was demonstrated by Halstedt, of Philadelphia, who in 1885 injected the inferior dental nerve for tooth extraction. Cocaine was taken up all over the globe by all who practised the healing art. It was used in 2 to 20 per cent. solutions, and no sooner was it employed here, a new use was found for it there, but soon severe cases of poisonings and fatalities began to be reported. The new gift offered to humanity proved a double-edged sword. By virtue of its wonderful anaesthetic properties, undreamed-of advances were made in all specialties in medicine, but its use frequently proved dangerous, and the number of cocaine fatalities is much greater than those reported.

Physiologic Action of Cocaine

The symptoms of cocaine poisoning vary in different individuals. In most cases small quantities produce some excitement, pleasurable and disagreeable. The patient is generally more garrulous than in ordinary life, often somewhat anxious

and confused. Very small doses produce a calm, languorous state, somewhat resembling that followed by taking small quantities of morphine, but differing from it in there being less tendency to sleep. *The pulse is accelerated, the respiration quick and deep, the pupil generally dilated,* and headache and dryness of the throat are frequently complained of. The reflexes may be a little exaggerated and tremors or slight convulsive movements may occur. Later powerful tonic or clonic convulsions supervene, the heart becomes extremely accelerated, the breathing becomes rapid and dyspnœic and may finally be arrested during a convulsion. In other cases the convulsive seizures are almost entirely absent, and fainting and collapse occur. The skin is cyanotic and cold, the heart slow and weak; the respiration is very much depressed, and death follows from its gradual cessation. Vomiting is occasionally seen at an early stage, but is by no means common.

The general action of cocaine seems to indicate a stimulation of the central nervous system. Thus the talkativeness so often produced by the drug indicates an increased activity of the cerebrum, and the increased movement in lower animals distinctly points to an affection of this part of the brain, for the movements are perfectly coördinated, and in the early stages resemble exactly those performed by the normal animal in a state

of excitement. Further evidence of the action of cocaine on the cerebrum is shown by its effects on muscular work.

The action of cocaine on the central nervous system is primarily a descending stimulation, the cerebrum being affected first, then the hind brain and medulla oblongata, and last of all the spinal cord. Perhaps it might be better expressed by saying that after small quantities the chief symptoms arise from the cerebrum, but as the dose is increased those from the lower part of the central axis become more prominent. After stimulation there succeeds depression, which follows the stimulation downward, affecting first the cerebrum and then the lower divisions. The two stages are not definitely divided, however, one part of the cerebrum showing distinct depression, while another is still in a state of excessive activity. In some cases, especially in man, the stage of excitement may be very short or apparently absent, and the whole course of symptoms then point to medullary depression.

In some instances there obtain erotic illusions and incoördinate hallucinations; the operator should be mindful of these effects, as the effects of a local anæsthesia, just the same as narcosis, may place him in an embarrassing position. Prof. Fischer quotes Ritter, who reports the following case:

According to Hentze, a young lady presented at a clinic and had a tooth removed under local anæsthesia. She showed symptoms of cocaine intoxication and hysteria; however, recovered very soon and returned to her home. Soon thereafter one of the assistants received letters from her of amorous character, though she even did not know the assistant's name. The assistant paid no attention to these notes, and three days later the young woman committed suicide, after notifying the assistant of her intention. It was determined the young woman was of unrepachable character and engaged to be married. Her actions, no doubt, were caused by the reaction of the cocaine producing erotic conditions of the mind.

The author himself observed several cases of marked sexual excitement followed by orgasm, while the patient was lying in the chair, showing symptoms of cocaine intoxication, resulting upon local anæsthesia induced for the extraction of teeth.

Respiration after cocaine is much accelerated, owing to central stimulation. At first the depth is not changed, but as the acceleration progresses the air inspired with each breath gradually becomes less. During convulsions the respiration is irregular or ceases, but it recovers again in the intervals, until after a very violent paroxysm it fails to be reinstated. In other cases the breathing be-

comes slower and weaker after a time, and eventually stops from paralysis of the center.

The circulation is altered by cocaine, owing to its action on the heart and on the vessels. The heart is much accelerated in mammals, while in the amphibians this is less often observed. The quickening has been ascribed to paralysis of the inhibitory terminations, but this seems not to be the case, for stimulation of the vagus slows the heart even late in the poisoning. The heart is accelerated, then either by direct action of the muscle or by stimulation of the accelerator mechanism. It is often slow before death, but apparently not invariably, and this is probably due to direct action on the muscle.

The vessels are much contracted in the earlier stages of poisoning, and this, together with the increased rate of the heart, leads to a very considerable rise in the blood pressure. The constriction of the vessels seems partly due to stimulation of the vaso constrictor center, for section of the splanchnic nerves leads to direct fall in the arterial tension. Cocaine seems to act directly upon the walls of the blood vessels, as its local application is followed by constriction of the vessels and blanching of the mucous membrane.

The effects on the peripheral *nerves* and *muscles* are still disputed.

The *urine* is sometimes said to be increased by

cocaine, while in other instances its injection has been followed by anuria lasting several hours. The other secretions seem rather reduced.

The *temperature* rises in cases of poisonings as much as 3-5 C.

The elimination of cocaine from the organism is still a muted question. In dogs a portion is excreted by the kidneys, the greatest portion, 95 per cent., being destroyed in the tissues. In the rabbit it is completely oxidized. In man the final state of cocaine is not definitely established.

Local Effects of Cocaine

Cocaine applied locally in most parts of the body produces a loss of sensation by its paralyzing the *terminations of some of the sensory nerves*, particularly those conveying impressions of pain and touch. It is often stated that the end organs of the nerves concerning which the feeling of heat and cold are also disorganized, but the researches of Kiesow show that this is incorrect, and that heat and cold are recognized as readily as in the unaffected parts of the body. Cocaine applied to the *tongue* removes the taste of bitter substances, while sweet and acid fluids lose their taste only partially, and salt is recognized as easily as usually.

A solution applied to the *nasal mucous membrane* paralyzes the sense of smell entirely.

Anæsthesia or insensibility to pain and touch may be induced in any of the mucous membranes that can be reached by cocaine in sufficient concentration—pharynx, larynx, œsophagus, stomach, nose, eye, urethra, bladder, vagina and rectum.

Applied to the unbroken skin, its effects are less marked, as it penetrates but slowly through the horny epidermis; but when the epidermis is removed by abrasions or by skin disease, the cutaneous organs of sensation are acted on in the same way as those of the mucous membrane.

The deeper sensory terminations can also be acted on by hypodermic injections, which causes a feeling of numbness and the relief of pain in the part. Hypodermic injection reaches not only the nerve terminations of the subcutaneous tissues, but also the finer nerve bundles, and these, too, are rendered insensible as far as the solution extends to them.

The part may, therefore, be cut into or be subjected to other surgical treatment without pain, as long as the knife does not pass beyond the area to which the drug has penetrated, and numbers of grave surgical operations have been performed under local anæsthesia produced by cocaine. Injected into the neighborhood of a nerve trunk, cocaine penetrates into the fibres and induces anæsthesia of the organs supplied by that nerve, and injected into the spinal canal causes anæsthesia

over large areas of the body, sometimes over almost the whole body. This is probably due to its acting on the posterior roots of the cord. It must be noted that the anæsthesia is only produced by the local applications of the drug. The internal administration only leads to a partial loss of sensation in the throat and stomach, and no anæsthesia is induced by its action after it reaches the blood vessels. The reason for this evidently is that, in order to paralyze the sensory fibres and terminations, a considerable amount of the drug is required, but much less is necessary to paralyze the central nervous system when cocaine is applied to a mucous membrane surface; it produces, besides loss of sensation, a feeling of constriction and a distinct pallor and contraction of the vessels, which points to a local action on the vessel walls: The anæsthesia produced by cocaine is comparatively short, but varies with the strength of the solution applied and with the vascularity of the part; as soon as the cocaine is absorbed, the local action disappears and sensation returns.

Cocaine can be looked upon as a *general protoplasmic poison*; muscles, nerves and nerve ends cease to contract or to conduct stimuli when exposed to even very dilute solutions of cocaine; the ciliated epithelial cells, leucocytes and spermatozoa become motionless; the cortical nerve cells lose their excitability, and many of the inverte-

brates are killed by even short exposure to cocaine. The movements of protoplasm in plants are also retarded or entirely suppressed, and putrefaction is delayed considerably. In some cases, notably in the higher invertebrates, the final depression is preceded by a stage of increased movement. In other instances, however, cocaine induces only depression and paralysis.

From the above we note that, though cocaine has proven of inestimable value, at the same time it is a powerful poison, and chemists and investigators all over the world have been trying to produce agents which possess the anæsthetic properties of cocaine but are devoid of its toxic qualities. The substitutes offered for cocaine as anæsthetic agents are many; however, all had their shortcomings: either their toxicity was practically equal to that of cocaine, or if they were less poisonous, the anæsthesia produced by these agents was not satisfactory; certainly it did not prove equal to that of the coca leaf alkaloid.

Novocain

After many substitutes for cocaine were brought out and found wanting, Prof. Einhorn, of Munich, in 1905 produced hydro-chlorid of p-amino-benzoyldiethylaminæthanol, which received the trade name "Novocain."

BIBLIOGRAPHY: Cushing, Pharmacology and Therapeutics. Braun, Die Lokalanaesthetica. Hare, Practical Therapeutics.

Dr. J. Biberfeld experimented with the new drug at the Pharmacological Institute of the University of Breslau, which experiments gave the following data:

Novocain possesses the same action upon sensory nerves as cocaine; a 0.25 per cent. solution suffices to completely anæsthetize even heavy nerve trunks, such as the sciatic nerve, in about ten minutes. Applied locally it causes *no irritation*, even if used in strong solutions. The author applies pure novocain powder to the oral mucous membrane before making a mandibular injection, and has not seen any ill results after using it in about five hundred mandibular injections.

There appears practically no ill effect upon the system after its absorption in doses which would be dangerous if cocaine were used. Neither the circulation, respiration or cardiac activity seem to suffer. Two to three grains (0.15-0.2 gr.) of novocain injected subcutaneously into a rabbit hardly showed a change in the blood pressure or the respiratory curve. Novocain does not produce mydriasis, does not change the introöcular pressure, and does not affect peripheral vessels, as cocaine does.

The toxicity is very low compared to cocaine, and was determined by comparing the lethal dose of novocain with that of cocaine, and stovain in animal experiments.

Lethal dose per kilogram of bodyweight; drug administered subcutaneously:

	Cocaine	Stovain	Novocain
Rabbit.	0.05-0.1 g.	0.15-0.17 g.	0.35-0.4 g.
Dog . . .	0.05-0.07 g.	0.15 g.	0.25 (not lethal)

Similar results were obtained experimenting with frogs, rats and cats, using the drug not only subcutaneously, but also intravenously. Introducing novocain into the spinal canal also demonstrated it to be less toxic than any local anæsthetic ever produced.

The results of laboratory experiments show novocain to be about seven times less toxic than cocaine. The writer, however, is inclined to place the toxicity even lower than that, and considers it about ten times less toxic than the coca product. The writer in operating for a cyst of the upper jaw once used 9 ccm. of a 2 per cent. solution of novocain, thus giving 0.2 g. (3 grains) without causing alarming symptoms.

European literature abounds with favorable reports on the use of novocain, and many pages could be covered with the enthusiastic reports by clinicians of all medical specialties. It is being used more and more in this country, and Prinz, of St. Louis; Blum, of New York; Riethmuller, of Philadelphia; Thoma, of Boston; Cunningham, Schamberg, Vaughn and others are advocating its use warmly. "Einhorn really seems to have dis-

covered the local anæsthetic." In spite of all, the writer would warn against the thoughtless indiscriminate use of the drug, but impress the reader that, though we have an agent that is a great deal less toxic than cocaine, we still have to study our patients and use judgment, and never forget the meaning of the word asepsis.

Novocain is manufactured in three forms:

1. Basic novocain.
2. Novocain nitrate.
3. Novocain hydrochlorate.

The basic form is mainly used in otology, rhinology and laryngology in 10 per cent. solutions in oil for applications, instillations and inhalation.

The nitrate is particularly of value in urological practice, as the nitrate of novocain can be combined with silver salts, which is not possible with the chlorate, the latter decomposing, and thus losing its properties.

Adrenalin

The findings of Corning (1885), that cocaine injected into an anæmic area will produce anæsthesia in weaker solutions and lessen the toxic effects due to a smaller amount being absorbed into the general circulation, became of practical use when, in 1901, Takamine and Aldrich, independent of each other, produced the extract of the suprarenal capsules known as adrenalin.

The most characteristic action of adrenalin is a temporary raising of the blood pressure, even if administered in minute quantities. According to Moore and Purrington, given to dogs in 0.000000245-0.000024 gm. for each kilogram of bodyweight, its action is discernible.

The reason for this reaction is due to direct cardiac stimulation, and also to the contraction of arterioles and capillaries.

The action of novocain is enhanced by adding a small quantity of adrenalin or suprarenin synth. The "E" novocain suprarenin tablets made by the Höchst Farbwerke Co. contain novocain 0.02 gram and suprarenin 0.00005 gram, and are the most convenient for dental practice.

Where large quantities of novocain are used it is probably better to make up a 1½ or 2 per cent. solution of novocain and then add 1 drop of suprarenin for each ccm. of novocain solution.

Any systemic symptoms which may appear after the hypodermic injection of novocain, suprarenin namely, the blanching of the patient, perspiration and slight nausea, are due to suprarenin, and not to the novocain. In old people with hardened vessels and in arteriosclerosis, as well as wherever there is an abnormal high blood pressure, it is advisable to reduce the amount of suprarenin.

V

INFILTRATION ANÆSTHESIA

INFILTRATION anæsthesia is the regional loss of sensation produced by the action of certain agents upon sensory nerve endings introduced by subcutaneous or submucous injection.

How these agents act upon the nerve tissue directly has not been established yet. We only know the result of such action, namely, a disturbed physiologic function, which in sensory nerve tissue is exhibited by loss of sensation.

The author believes that when an agent like cocaine, or a similarly acting drug, is brought in contact with nerve tissue, there occurs a precipitation or coagulation of some of the cell contents (albumins), which altered biologic state produces the loss of function; after this precipitate is eliminated by absorption or is redissolved within the cell body, the normal function is reëstablished without *apparent* injury to the nerve tissue, and sensation returns. This will very likely account for the transient character of the drug effect.

In employing local anæsthesia it is not only essential to be acquainted with the local and physiologic action of the drugs used, but a thorough knowledge of the anatomical and histological

structure of the parts to be anæsthetized is required.

The jaws primarily present two types of osseous structure: first, spongy portions, rich in canals and spaces; and, second, solid portions, very poor in perforations.

In view of the fact that local anæsthesia depends upon the absorption of the anæsthetic, it is apparent that those parts which are cancellous in



FIG. 85

Showing Porous Character of Upper Jaw and Area of Spongy Structure in Anterior Portion of Mandible. I. Infraorbital Foramen. E. O. L. External Oblique Line. M. Mental Foramen.

structure will be anæsthetized more satisfactorily than the solid areas.

The upper jaw is more porous in structure than the mandible. The lower maxilla being porous only in the anterior portion, between the canine teeth, infiltration anæsthesia will prove more effective here than in the bicuspid and molar regions, where the bone is denser in character (Fig. 85).

Another point to bear in mind is the fact that the maxillary bones are more porous in early life, and with advancing years grow more compact and denser; thus it will be easier to induce anæsthesia with less of the drug in children than in adults.

Local or infiltration anæsthesia can be employed upon single or groups of teeth in the anterior part of the mandible and in the upper jaw, provided there is no infection present.

The Technique of Infiltration Anaesthesia

Successful local anæsthesia depends upon three factors: local asepsis, the use of the proper solution, and correct technique. The second factor has been discussed elsewhere.

Local asepsis is obtained by applying tr. iodine to the part to be injected. This is best done with an applicator, made by tightly winding some absorbent cotton around one end of a toothpick.

This method is simple, inexpensive and clean, as the applicator is discarded after use.

The technique of local anæsthesia requires the *proper introduction of the needle, the correct method of injecting* the anæsthetic, and *waiting* a sufficient length of time, until the anæsthetic has affected the nerves supplying the part to be operated upon.

After the anæsthetic has been prepared, the syringe is filled and the needle attached. Air bubbles within the barrel are expelled by holding the syringe upward, and the air will then raise to the top; by slowly expressing a few drops of solution through the needle, the advancing liquid will force out the air. Air injected into the tissues may produce pain. It is better to fill a syringe *before attaching* the needle, as if more anæsthetic solution is required the operator (once having acquired the habit) is less apt to place the bloody needle into the solution, and thus taint the inside of the syringe, as some of the material adhering to the needle, leaving the tissues, will be set free in the solution. If a platinum needle is used, heating it in the flame will sterilize it, of course.

If a needle is removed or attached to the syringe, it should be handled with forceps, as the fingers destroy its sterility.

Having filled the syringe and expelled air bubbles which may be present, *it is grasped like a pen-*

holder, and the tissues having been iodized, the needle is thrust into the gum until bone is reached. The flattened portion of the needle should always lie parallel to the bone. If inserted otherwise, the needle is apt to bend and break (Fig. 87).

The needle should not be inserted at the gingival border, but higher up toward the apex of the root (Fig. 88).



FIG. 86

Showing Porous Character of Upper Jaw, in Posterior Portion—Shows Tuberosity of Upper Maxilla—Also Demonstrates the Dense Character of the Mandible in the Posterior Portion of the Body.

When the bone is reached the liquid should be slowly and evenly injected subperiostially, and the area then massaged. Wheals should not be formed; if such is the case, the liquid has not been injected deep enough and has spread just below

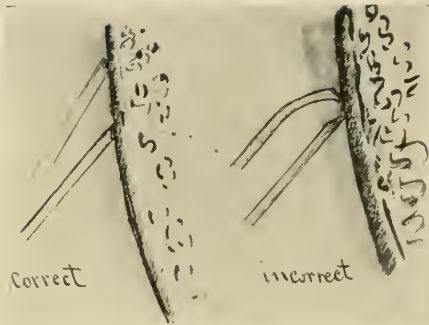


FIG. 87

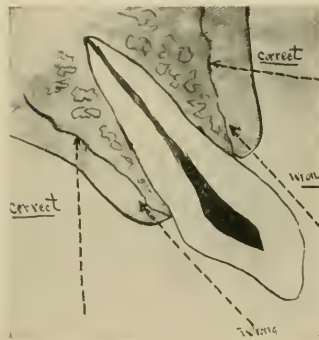


FIG. 88

Shows Correct and Incorrect Method of Inserting Hypodermic Needle.

the superficial layer of mucous membrane. Sufficient time should elapse to allow absorption to take place, as the resulting anæsthesia is *not due*

to pressure, but induced by the solution reaching the nerve endings through absorption. This means about three to five minutes. The efficacy of the anæsthesia can be tested by pricking the infiltrated area with the hypodermic needle. After the superficial area is anæsthetized we have to wait until the solution traverses the alveolar process to the pericementum. Fig. 89 shows the proper method of inducing infiltration anæsthesia. Infiltration anæsthesia can be used with good success in those areas of the maxillæ which are spongy and present many small foramina; but in those localities where the bone is dense, as in the molar and bi-



FIG. 89
Infiltration Anæsthesia in Anterior Portion of Upper Jaw. Note Position of Syringe.



FIG. 90

Infiltration Anaesthesia on Lingual Aspect of Lower Molar Region

cuspid region of the mandible, the infiltration method will not be successful, and we have to resort to the conductive method. Another point to remember is that we may not infiltrate any infected area, as septic material will be forced into adjacent tissues, and a very poor or no anaesthesia is obtained. The infiltration method has its decided limitations, and as conductive anaesthesia will do all that which infiltration anaesthesia will accomplish, it is far superior in efficacy.

The advantages and disadvantages of the two methods are:



FIG. 91

Anæsthesia by Infiltration in Lower Jaw, Canine Region

Infiltration:

1. Lasts a short time.
2. Anæsthesia confined to injected area.
3. Infected tissue cannot be anæsthetized.
4. More frequent injections required.

Conductive:

1. Lasts longer.
2. Anæsthesia extends throughout whole area of nerve supply.
3. By blocking off the nerve at its foraminal exit, distal infected areas are anæsthetized.
4. Fewer injections required.

5. More extensive and larger operations can be performed.
6. The anæsthesia lasting so much longer, post traumatic pain is greatly reduced.
7. Less of the actual drug required.

VI

ANATOMICAL CONSIDERATIONS

THE anatomical considerations in this chapter should merely serve to recall to the reader's mind the most important landmarks essential for the practice of local anæsthesia; for more careful study, which is essential, the student is referred to special works on anatomy. The upper jaw is supplied by the superior maxillary nerve, the second division of the trigeminus, and the upper teeth can be divided into three groups, according to their nerve supply.

The *central and lateral incisor and canine teeth* are supplied by the *anterior superior dental branch*; the *bicuspid*s, by the *middle superior dental branches*, and the *molars* by the *posterior superior dental branches* on each side.

The middle superior branches communicate with the posterior superior dental branches by a thickening called the ganglion of Valentine, and with the anterior superior dental branches by an enlargement called the ganglion of Bochdalek.

The *anterior superior dental branch* is given off from the superior maxillary nerve just before its exit from the infraorbital foramen.

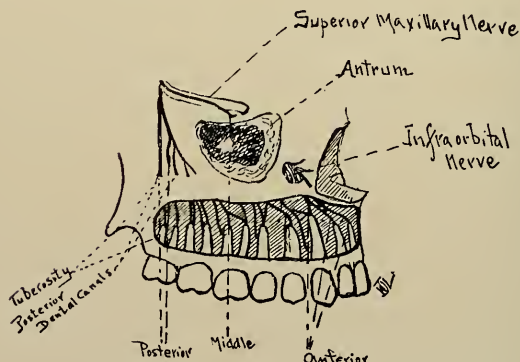
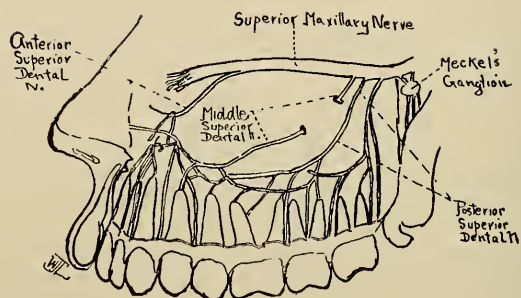
The *middle superior dental branch* is given off from the same nerve in the back part of the infra-orbital canal, and runs downward and forward in a canal in the outer wall of the antrum.

The *posterior superior dental branches* arise from the trunk of the superior maxillary nerve just as it enters the infraorbital canal, running downward on the tuberosity of the upper maxilla, entering the *posterior dental canals* on the zygomatic surface of the bone.

In order to anæsthetize these various branches we have to block them as they enter or leave their bony foramina. Thus to reach the *anterior superior dental branch* we have to make an injection at the *infraorbital foramen*; this will anæsthetize the central, lateral and canine teeth, and by osmosis via the ganglion of *Bochdalek* affect sensation in the *middle superior dental branch*, and therefore anæsthetize the bicuspid more or less.

If the *molars* are to be anæsthetized, the *posterior superior dental branch* must be injected at the tuberosity, blocking off the nerves as they enter the *posterior dental canals*. If this is done, in the majority of cases the middle branch is also affected by osmosis through the ganglion of *Valentine*, thus also anæsthetizing the *bicuspids*.

As the superior Middle Dental Branches, supplying the bicuspid, anastomose with both the posterior and anterior dental nerves, the anæ-



FIGURES 92 AND 93

Showing the Nerve Supply of the Various Groups of Teeth. The Posterior Superior Dental Nerve Supplying the Molars, the Anterior Superior Dental Nerve Supplying the Central and Lateral, as Well as the Canine and the Middle Superior Dental Nerve Supplying the Bicuspid. Also shows the Anastomoses Between the Different Branches.

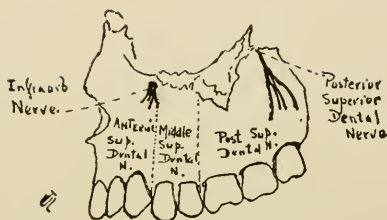


FIG. 94

Shows the Posterior Superior Dental Nerve, Entering the Superior Maxilla upon the Tuberosity by the Posterior Dental Canals.

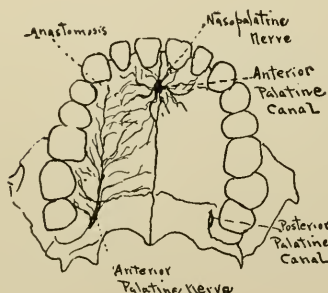


FIG. 95

Shows the Nerve Supply of the Hard Palate, The Naso-Palatine Nerve Emerging Through the Anterior Palatine Canal, Supplying the Anterior Portion of the Palate, the Anterior Palatine Nerve Emerging Through the Posterior Palatine Canal, Supplying the Posterior Portion of the Palate.

thetization of the bicuspid sometimes becomes difficult by the conductive method. If we inject the anterior branch we get anæsthesia in the first bicuspid, sometimes also in the second premolar; injecting the tuberosity, the second bicuspid may

or may not be affected. It therefore may be necessary to inject the tuberosity, posterior dental canal and infraorbital foramen to produce the required result. In preference to such complicated injection, the infiltration of both bicuspsids both on the palatine and facial aspect will be the simpler method.

The hard palate is supplied by *two* nerves: the *naso-palatine*, one of the internal branches of the spheno-palatine ganglion, which nerve, after supplying part of the nasal fossæ, passes downward and forward, entering the mouth through the *anterior palatine canal*, supplying the mucous membrane behind the incisor teeth.

The posterior portion of the palate is supplied by the *anterior palatine nerve*, one of the descending branches of the spheno-palatine ganglion, descending through the *posterior palatine canal* and emerging upon the hard palate through the *anterior palatine foramen* opposite the last molar tooth, supplying the palate as far as the canine teeth, the gums, mucous membrane and glands of the palate anastomosing with the *naso-palatine nerve*.

To anæsthetize the *anterior* part of the palate the *naso-palatine nerve* is reached as it leaves scarpas foramina, by injecting the *anterior palatine canal*; and to anæsthetize the *posterior* portion of the palate, the *posterior palatine canal* is

injected, opposite the last molar tooth, which will anæsthetize the *anterior palatine nerve* (Fig. 95).

The anterior superior dental branch gives off a nasal branch supplying the mucous membrane of the forepart of the inferior meatus and the floor of the nose, communicating with the nasal branches from the sphenopalatine ganglion.

For this reason a more complete anæsthesia in the anterior part of the jaw can be obtained by placing a tampon saturated with the anæsthetic solution into the anterior nares. In injecting about the infraorbital foramen, besides producing anæsthesia in the anterior superior dental branches, other branches of the superior maxillary nerve are reached, thus affecting the nasal and labial branches, producing an anæsthesia in the upper lip and sometimes extending to the side of the nose.

The lower jaw or mandible is supplied by the inferior maxillary or mandibular nerve, the third branch of the trigeminus.

It distributes branches to the teeth and gums of the lower jaw, the lower part of the face and lip, the muscles of mastication, the integument of the temple and external ear, as well as the tongue.

Its largest branch, the inferior dental nerve, is of greatest interest to the dentist, as this branch supplies all lower teeth with sensation. It passes downward with the inferior dental artery beneath

the external pterygoid muscle and then between the internal-lateral (spheno-mandibular) ligament and the ramus of the jaw to the dental foramen. It then enters the mandibular canal lying beneath the teeth as far as the mental foramen, where it divides into the incisor and mental branches, the former supplying the canine and incisor teeth, the latter the skin of the chin and mucous membrane of the lower lip. These branches arborize with the facial nerve, and for that reason we frequently note a drooping of the facial muscles after mandibular injections.

The molars and bicuspid are supplied by branches given off from the mandibular canal.

The *lingual nerve* supplies the papillæ and mucous membrane of the anterior two-thirds of the tongue, and lies beneath the external pterygoid muscle, very near and on the inner side of the inferior dental nerve; in fact, it sometimes is joined to it by a branch. It communicates with the inferior dental and hypoglossal nerves, the submaxillary ganglion and with the facial nerve through the chorda.

The proximity of the lingual nerve to the inferior dental nerve explains why in injecting the mandibular nerve anæsthesia of one-half of the tongue is obtained, and also the reason for not getting anæsthesia on the lingual aspect of the alveolus, when the lips and facial aspect may be

devoid of sensation. Some branches of the lingual contribute to the nerve supply of the lingual aspect of the alveolar process.

The *buccal* or *buccinator* nerve supplying the facial aspect of the mucous membrane in the molar and bicuspid region must be remembered, and it may have to be blocked off separately to get perfect anæsthesia. Williger, of Berlin, advocates a separate injection into the mucous membrane of the cheek below Stenson's duct; the author, however, finds that an infiltration in the region of the second molar is sufficient to produce the desired effect. In fact, in the majority of mandibular injections, if properly done, no second injection of any kind is required.

VII

THE TECHNIQUE OF CONDUCTIVE ANÆSTHESIA

The Mandibular Injection

IN ORDER to practice conductive anæsthesia, or nerve blocking, it is essential to remember those landmarks which will enable the operator to lo-



FIG. 96

a. Coronoid Process; b. Condyloid Process; c. Sigmoid Notch; j. Body of Mandible; k. Ramus; l. Angle; e. Mental Foramen; g. Mylo-hyoid Ridge, Terminating as Mylo-hyoid or Internal Oblique Line; d. External Oblique Line; h. Trigonum Retromolare, formed by the External and Internal Oblique Lines and the Distal Surface of the Last Molar Tooth; $\square$ Lingula, the Bony Spine directly above the Inferior Dental Foramen f. to show the Foramen and Lingula to better advantage, the Lingula has been shaded with ink.

cate the foramina transmitting the nerves to be anæsthetized. In the mandible or lower jaw we have to bear in mind the inferior dental foramen (Fig. 96), and the mental foramen (Fig. 96). The inferior dental foramen is found by placing the index finger on the facial aspect of the alveolar process and palpating for the external oblique line (Fig. 97). Having located this, the finger is



FIG. 97

slowly passed backward and upward along the external oblique line until the anterior border of the ramus is plainly felt. The patient is then directed to relax the muscles by slowly shutting his mouth



FIG. 98

Showing Finger-Tip Placed in the Right Retromolar Triangle. The Finger Is Slightly Tilted.

half way. The object of this relaxation is to be certain that the operator is actually following the bone and not palpating the internal lateral ligament, which in some cases when put on the stretch, when the mouth is open, may be mistaken for the bone. When the muscles are relaxed, in shutting the mouth the ligament also relaxes and is pushed out of the way. After the finger has followed the external oblique line, the tip is placed behind the last molar, and the mylohyoid ridge is palpated. The finger-tip is then slightly tilted lingually, and placed in the triangular space formed by the external and internal oblique lines, and the distal surface of the last



FIG. 99

Finger in Retromolar Triangle in the Mouth; the Cheek and Lips Are Retracted to Show the Finger in Position.

molar. This space is known as the retromolar triangle or *trigonum retromolare* (Fig. 98).

The finger having been placed in the retromolar triangle tilting linguallly (Fig. 99), the syringe, being held in the right hand like a penholder, is now introduced into the mouth, that the barrel is placed across the canine or first bicuspid of the opposite side, and the needle point rests just above the nail of the index finger of the left hand (Fig. 100).

The point is thrust quickly through the mucous membrane till it strikes the bone; this will give us



FIG. 100

Showing Position of Index Finger in Retromolar Triangle, Right Hand Holding Syringe; the Instrument Is Held Like a Pen-holder and Placed Diagonally Across the Dental Arch, One End Crossing the Bicuspid Region, the Needle About to Pierce the Mucous Membrane 1 cm. Above the Morsal Surface of the Molar Teeth, Resting on the Nail of the Left Index Finger.

a level just about 1 cm. above the morsal surface of the molar teeth (Fig. 101).

The syringe is now rotated toward the side, to be anæsthetized, the needle point never losing its contact with the ramus (Fig. 102).

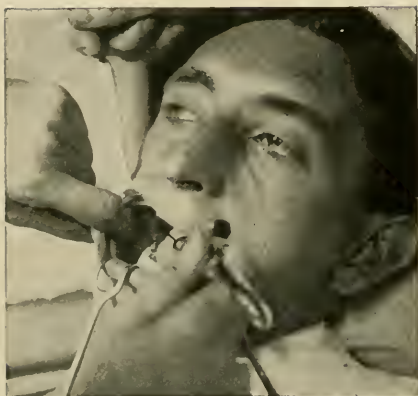


FIG. 101

Shows Position of Syringe, After Mucous Membrane Has Been Pierced and Index Finger Withdrawn.

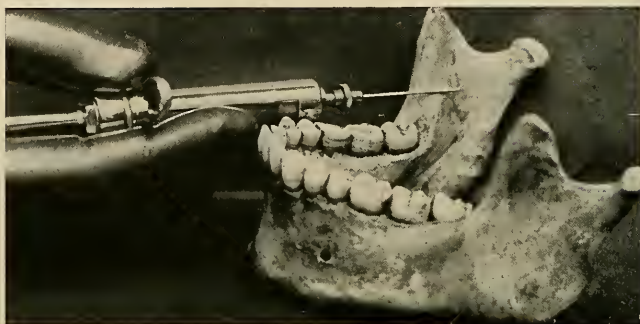


FIG. 102

Shows Position of Syringe After It Has Been Rotated Toward the Side to Be Anæsthetized, Just Prior to Thrusting the Needle Along the Lingual Aspect of the Ramus.

In bringing the syringe around from the left towards the right side, the instrument describes an arc, as shown in Fig. 103.

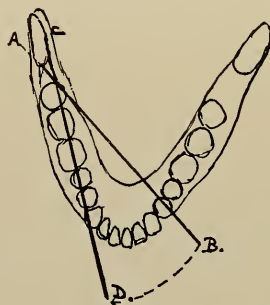


FIG. 103

A. B. Indicates the Position of the Syringe as the Needle Is Thrust Through the Mucous Membrane, Striking the Ramus; C. D. Shows the Position of the Syringe When the Operator Is Ready to Slide the Needle Along the Ramus to Enter the Spatium Pterygo-Mandibulare, D.B.Arc Described by Distal End of Syringe.

The lingual or internal surface of the ramus is now slowly palpated, and thereby the needle slides along the bone, gradually approaching the inferior dental foramen (Fig. 104).



FIG. 104

Syringe Brought Around, Just Before the Needle Is Slid Along the Ramus; Corresponds to Line C. D. in Fig. 103.



FIG. 105

Making the Actual Injection

When the needle passes the lingula mandibulæ the contact of bone is lost, and we have entered the spatium pterygo-mandibulare.

Our needle has disappeared almost entirely. The writer now employs a slight lateral movement, attempting to palpate the lingula, and then slowly and evenly empties the contents of the syringe, drawing the needle slightly in and out. By the lateral and in and outward motion the lingual nerve is usually anæsthetized.

On the left side the same technique is employed, palpating with the right and holding the syringe in the left hand. The injection can also be made with the right hand, but then the thumb of the left hand is used instead of the index finger, and placed in the trigonum retromolare, the operator standing at the side or behind the patient (Figs. 112, 113); otherwise the technique is identically the same as executed on the right side.

Tuberosity Injection

The tuberosity of the upper maxilla is reached by thrusting the needle into the buccal fold opposite the disto-buccal root of the second upper mo-



FIG. 106
Palpating Facial Aspect of Alveolar Process



FIG. 107
Placing Index Finger in Retromolar Triangle



FIG. 108
Placing Syringe



FIG. 109
Piercing Mucous Membrane

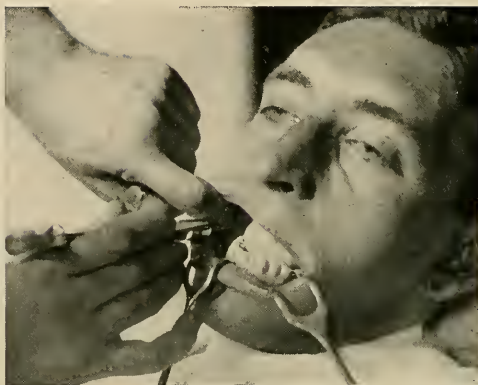


FIG. 110

Bringing Syringe Toward Side to Be Anæsthetized



FIG. 111

Entering Spatium Pterygo-Mandibulare and Emptying Syringe



FIG. 112
Placing Thumb into Retromolar Triangle on Left Side



FIG. 113
Introducing Syringe and Piercing Mucous Membrane of Left Side; the Other Steps Are Identical as Carried Out on the Other Side.

lar, and passing it upward and backward (Fig. 114). The needle should keep in contact with the bone.



FIG. 114
Making Tuberosity Injection

Posterior Palatine Injection

The posterior palatine canal, which terminates upon the palate opposite the third molar as the anterior palatine foramen, giving exit to the anterior palatine nerve, is reached by thrusting the needle into the palatine mucous membrane about $\frac{1}{2}$ - $\frac{3}{4}$ cm. inside (toward the median line) of the third molar. In many subjects there appears a tiny depression in the mucous membrane at this site.



FIG. 115

Injecting the Posterior Palatine Canal

By injecting the tuberosity and blocking off the anterior palatine nerve, the three molars are completely anæsthetized. The palatine surface loses sensation up to the canine tooth. In many instances the second bicuspid also becomes anæsthetized by the tuberosity injection.

Anterior Palatine Injection

To block off the naso-palatine nerve, by injecting the anterior palatine canal, the needle is thrust into the posterior aspect of the incisive papilla, which is situated about $\frac{1}{2}$ cm. posterior to the central incisors. The needle is directed upward and backward (Fig. 116). About seven drops are

used for this injection; this will anæsthetize the anterior portion of the hard palate in the incisal region. (See Cases 72, 99, in Anæsthesia Reports.)

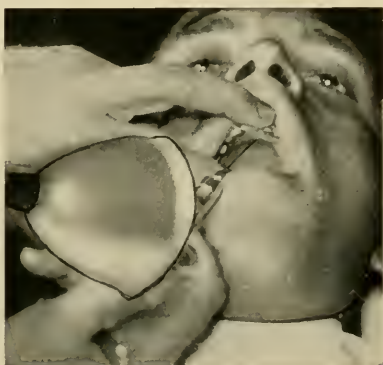


FIG. 116

Injecting the Anterior Palatine Canal

Infraorbital Injection

To find the infraorbital foramen, palpate the superior border of the orbit and locate the supra-orbital notch; the infraorbital foramen is found below the inferior border of the orbit in a fairly straight line with the notch; place the index finger on the lower border of orbit, introduce the thumb into the vestibule of the mouth and lift up the upper lip, drawing it upward and forward. The needle is now thrust into the muco-buccal fold opposite the index finger, which will be found just

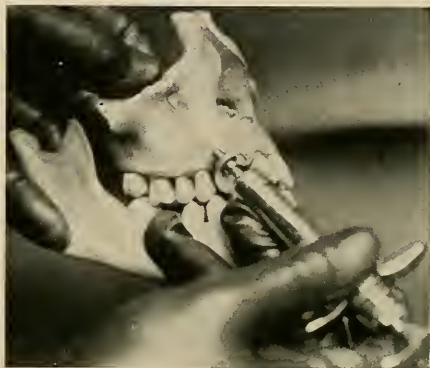


FIG. 117

Injecting Infraorbital Foramen on Skull. Note Direction of Needle and Syringe.



FIG. 118

Making Infraorbital Injection. Note Position of Left Hand

about above the canine tooth. Inject drop by drop, as you go along, until you feel the foramen with the needle, depositing about 1 ccm. at the opening of the canal. A little massage will drive the anæsthetic into the foramen. (See Cases 72, 80, 89, 92, in Anæsthesia Reports.) (Figs. 117-118.)

Mental Injection

The mental foramen is reached by drawing the lip down with thumb and index finger and thrust-



FIG. 119

Showing Mental Injection on Skull. Note Location of Foramen and Direction of Needle.



FIG. 120
Injecting the Mental Foramen

ing the needle through the mandibular mucous membrane fold between the two bicuspid; slightly advancing the needle point toward the first bicuspid will cause it to enter the mental foramen (Fig. 120). About 1 ccm. of solution should be injected. About $\frac{1}{2}$ ccm. injected on the lingual aspect will anæsthetize the mucous membrane and periosteum. This will anæsthetize the two bicuspid and canine. If this injection is made on both sides, the six anterior teeth are completely anæsthetized. (See Case 47 in Anæsthesia Reports.)

VIII

INDICATIONS AND CONTRAINDICATIONS FOR LOCAL ANÆSTHESIA

LOCAL anæsthesia is indicated in dental and oral surgery in almost all cases.

The exceptions being the following:

1. Hysterical patients, or such who are extremely excited, and this state of excitement cannot be controlled by the administration of sedatives; these cases are better fit for general anæsthesia.

2. Patients who exhibit an idiosyncrasy against local anæsthetics. By this the writer does not mean the patient who says, "I want gas, or I want ether," but cases who actually show an unusual physiologic reaction against the drugs used. The writer has never seen or heard of a case of idiosyncrasy against novocain.* The patient who wants this or wants that must be given to understand that he has no choice in the matter, but that

*By this the author means that he has never seen any case which exhibited alarming symptoms after the use of Novocain. He has met cases where the anæsthesia was unsatisfactory; the patients upon inquiry stated that cocaine used on previous occasions either had made them ill or failed to produce any anæsthesia at all or both. Dr. Geo. Rice of New York related a similar case to the author, wherein he could not obtain complete anæsthesia. The writer will use Novocain in cases where he would refuse to employ cocaine.

the selection of the anæsthesia rests with the operator. Some of the writer's most enthusiastic patients are those who at first objected to injections.

Patients who cannot tolerate cocaine are not necessarily unsuitable for novocain anæsthesia; we must remember that novocain is a great deal less toxic than cocaine. In employing novocain-suprarenin anæsthesia the operator must bear in mind that, although novocain itself does not affect the cardiac function or circulation in general, or the respiratory function, suprarenin raises the blood pressure. In old people and patients whose blood pressure is high, as those suffering from arteriosclerosis, it is wise to employ less suprarenin.

However, we must not be blind to the fact that there are individuals who possess idiosyncrasies against certain drugs, and undoubtedly cases will present who react abnormally to novocain in spite of its low toxicity. There are persons who can't eat strawberries, and others who can't partake of certain fish, although both are articles of food considered beneficial and nourishing. We simply have to watch our patients carefully, and if any untoward symptoms present, the further use of the drug is contraindicated. The writer, who has used novocain in several thousand cases, has not met with any direct idiosyncrasy against novocain,

but he recalls two cases who suffered from slight symptoms of poisoning after but normal injections.

Children, whose coöperation is difficult to obtain at times, prove unsuitable subjects. For extractions no anæsthetic at all, or a short general anæsthesia, will be the methods of choice in such instances.

3. Another contraindication for local anæsthesia is the presence of infection in the area where the injection is made; this does not imply the field of operation, but the area which the needle traverses. Thus we can induce mandibular anæsthesia in all cases, except where there is infection in the third molar region, as infected material may be carried into the spatium pterigo mandibularis, and thus serious infection, neuritis, arteritis or phlebitis in the mandibular area, or even infection of the deeper structures, may be produced. In other words, mandibular anæsthesia can be induced for all cases in the lower jaw excepting when the third molar is abscessed, or when a complete trismus is present, preventing the location of the inferior dental foramen. Analogous conditions exist in the upper jaw.

From this we learn that even conductive anæsthesia has its limitations, and any operator who would say that he has no use for inhalation anæsthesia at all is either limiting his work to suitable

cases or he is, to say the least, narrow-minded. To perfectly master any method means not only "how to use it," but also to know "when not to use it." There is no inflexible rule in medicine, as we are working on vital tissues and organs, which are controlled by a nervous system, whose condition is never alike in two individuals.

Local anæsthesia proves one of the greatest blessings ever given to medicine and dentistry, but we must know how to use this gift.

What more can we demand of any method of anæsthesia that insures us in the majority of cases:

1. Painless cavity preparation.
2. Painless pulp removal.
3. Painless tooth extraction.
4. Painless oral surgery.

The writer, who limits his practice to the last two, has been able to cut down his hospital cases to a small percentage, operating most cases in his office under conductive anæsthesia.

IX

INHALATION ANÆSTHESIA VERSUS CONDUCTIVE ANÆSTHESIA

It is true many operations can be performed by the induction of analgesia and anæsthesia through the use of nitrous oxide and oxygen; this method, however, does not do away with traumatic shock and requires cumbersome apparatus. Besides, no one can pay close attention to the anæsthesia, which is essential to get a good result and at the same time do an operation which demands attention to minute details, and all operations require that, if we are fair to our patients. If both are attempted by one individual, either anæsthesia or operation is bound to suffer, and the result cannot be perfect. If an operator attempts to do anything surgical, and during the anæsthesia his apparatus requires adjustment, which is bound to happen, he will soil his apparatus and destroy the asepsis of his hands by handling the anæsthetic machine. Besides, this dual rôle is bound to tell on the operator's nerves. Further assistance is, therefore, required, as well as the highest skill in general anæsthesia.

The apparatus is difficult to transport for cases to be operated upon outside of the office. Analge-

sia is frequently unsatisfactory, and therefore very trying to the patient. There are very few men who can accomplish with nitrous oxide oxygen what almost anybody can do with conductive anæsthesia, provided the fundamental principles of asepsis and a little anatomical knowledge are employed.

The use of other inhalation anæsthetics besides nitrous oxide or nitrous oxide and oxygen is dangerous, in spite of statistics. Ether ranks directly after nitrous oxide in safety. How many men use ether in their offices? The safest of all inhalation anæsthetics is nitrous oxide and oxygen, but it is the *most difficult to use*, with anything like uniform success. Success in anæsthesia means:

1. Safety to patient.
2. No ill after-effects.
3. Actual painless operation.

The first two are frequently accomplished; the latter frequently overlooked, as the operator does not feel the pain. The most reliable information on the last point can only be obtained from the patient. In a large percentage of cases where analgesia is employed patients will say, "I knew what was going on; I could not move or talk, but I felt pain," and pain means *shock*.

The writer does not mean to imply that an ideal analgesia or anæsthesia cannot be obtained by inhalation methods, but he means to state that in

many, many cases the operator does not meet with ideal results.* It is easier and less harmful to the patient and less difficult for the operator to obtain ideal results with conductive anæsthesia, *properly* induced. Failures will be met with by all methods; nothing is perfect in nature. If it were, there would be no need for physicians, surgeons or dentists.

Another disadvantage of inhalation anæsthesia is the necessity of administering it as long as lessened or abolished sensation is required. In nerve blocking with novocain, anæsthesia is maintained for a long time, usually for the whole length of the operation after anæsthesia has once been induced.

The advantages of conductive anæsthesia over general anæsthesia are:

1. Conductive anæsthesia (novocain) is less harmful to the patient than the continuous administration of an inhalation anæsthetic.
2. There is no cumbersome apparatus required.
3. The anæsthesia lasts a longer time.
4. There are no unpleasant after-effects.
5. The patient, not being unconscious, can assist the operator.
6. Hemorrhage is easier controlled.

*See Report of "Committee on Practice" of the Dental Society of the State of New York on analgesia. *Dental Cosmos*, November, 1914; page 1266.

7. Less assistance required than in inhalation anæsthesia.

8. Blocks off not only painful impulses, but also traumatic shock.

The writer advocates the use of conductive anæsthesia in all instances, excepting in cases where the third molars are abscessed. In simple extractions or operations which can be executed in twenty to thirty seconds, nitrous oxide or nitrous oxide and oxygen will prove more expeditious than anæsthesia by the conductive method, as conductive anæsthesia requires from ten to twenty minutes' time until complete cessation of pain is established. Small children are probably better served with inhalation anæsthesia; but, in the main, conductive anæsthesia has come to stay, and unquestionably will *almost* entirely displace inhalation analgesia and anæsthesia in dental and oral surgery.

If nitrous oxide and oxygen is used for longer operations, it should be administered by an expert and combined with local anæsthesia, after the method advocated by Crile.

X

SHOCK IN ORAL SURGERY

CRILE has shown that shock plays an important part in surgical practice. He showed that the cessation of pain by inhalation anæsthesia does not cut off traumatic shock caused by cutting tissue; also that the preoperative psychic state of the patient produces cerebral disturbances—shock. So that in operative procedures shock is caused by:

1. Anxiety of the patient.
2. Pain felt by the patient.
3. Traumatic shock by cutting tissue.

In ordinary inhalation anæsthesia, when the patient feels no pain, only one source of shock to the brain is eliminated. The preoperative psychic disturbance is allayed by the administration of sedatives—hypnotics as bromides, valerian and opiates.

Traumatic shock can only be done away with by nerve blocking; that is, the interposition of a drug which will inhibit impulses along the nerve trunks. For this purpose he employs novocain. To get an ideal anæsthesia he employs both a general and a local anæsthetic, preceded by a hypnotic. Thus he obtains a lack of sensation, a blocking of

afferent impulses and reduced cerebral impressions.

In employing nitrous oxide and oxygen, the safest general anæsthetic, we do not block off traumatic shock, nor do we reduce the shock caused by apprehension and fear on the part of the patient.

In using conductive anæsthesia *preceded by sedatives*, we come nearer to the ideal anæsthesia than by using any other method.

1. Apprehension and fear is reduced by giving bromural, or in extreme cases opiates.

2. By nerve blocking we not only cause a painless operation, but at the same time cut off impulses caused by traumatic shock.

It can be readily seen that analgesia induced by the inhalation of N_2O causes a certain amount of shock; and, therefore, conductive anæsthesia is the method of choice both in operative and surgical mouth operations.

XI

RECORDS OF CONDUCTIVE ANÆSTHESIAS

THE following tables show the record of one hundred and fifty conductive anæsthesias (excepting two by infiltration, Cases Nos. 149, 150) in oral surgical and operative dental cases, both in private and hospital practice. None of these are selected cases, but records of patients just as they presented. The first one hundred and ten anæsthesias were done by the author, both at home and at the German Hospital in New York. The forty records of operative dentistry cases were obtained through the courtesy of Dr. S. W. A. Franken, of New York, and Dr. H. F. Barge, of Long Island City, both of which gentlemen are associated with the author at the German Hospital Clinic.

Key to Tables

R.U.=right side upper jaw.

R.U.3.=right upper canine.

L.U.=left side upper jaw.

L.U.8.=left upper third molar.

R.L.=right side lower jaw.

R.L.7.=right lower second molar.

L.L.=left side lower jaw.

L.L.4.=left lower first bicuspid.

The Roman numerals indicate the age of the patient: VIII=patient is eight years old.

The amount of anæsthetic solution injected is expressed in *ccm.*

The amount of novocain used in a case is expressed in *grains.*

B.N.=buccal nerve.

Time of waiting=time elapsed between injection and beginning of operation.

A.P.C.=anterior palatine canal.

P.P.C.=posterior palatine canal.

Infilt.=infiltration.

Infra.o.f.=infraorbital foramen.

% Nov.=per cent. of novocain.

1.E.S.=one ccm. of solution injected on each side.

Nasal t.=nasal tampon.

CONDUCTIVE ANÆSTHESIA IN

Case Number	Private or Hospital	OPERATION Extraction unless otherwise stated	SITE OF INJECTION			Total am't of Sol. injected in ccm.	Per cent. Novocain	Total amount of Novocain used in gr.
			Inferior Dental Foramen	Mental Foramen	Infiltration			
1	P.	Impacted L.L.8	2injections 1 ccm. each	....	B.N. 1	3	11 $\frac{1}{2}$	33
2	P.	Unerrupted L.L.5	1	1	B.N. 1	3	11 $\frac{1}{2}$	33
3	P.	L.L.7	1	1	B.N. 1	3	11 $\frac{1}{2}$	33
4	P.	7.	1	....	B.N. 1	2	11 $\frac{1}{2}$	33
5	P.	L.L.6 Pericementitis	2injections 1 ccm. each	....	B.N. 1	3	11 $\frac{1}{2}$	33
6	P.	Removal of Tumor	.....	2 inj. 1 one a.s.	...	2	11 $\frac{1}{2}$	43
7	...	R.L.8. aet. VIII	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
8	...	R.L.6. aet. XV	1	....	B.N. 1	2	11 $\frac{1}{2}$	43
9	...	L.L.6. aet. XIII	1	....	B.N. 1	2	11 $\frac{1}{2}$	43
10	...	Abscessed L.L.6. aet. X	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
11	...	L.L.6. aet. X	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
12	P.	Impacted L.L.8	1	....	B.N. 1	2	11 $\frac{1}{2}$	43
13	...	L.L.6. aet. XIV	1	....	B.N. 1	2	11 $\frac{1}{2}$	43
14	...	Abscessed L.L.6. aet. X	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
15	...	R.L.6. aet. XVI	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
16	...	R.L.6. aet. XIII	2injections 1 ccm. each	....	B.N. 1	21 $\frac{1}{2}$	11 $\frac{1}{2}$	33
17	...	Abscessed L.L.6 aet. IX	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
18	...	R.L.6. aet. X	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
19	...	L.L.6	1	....	B.N. 1	2	11 $\frac{1}{2}$	43
20	...	L.L.6. aet. XII	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
21	...	L.L.6	1	....	B.N. 1	2	11 $\frac{1}{2}$	43
22	...	L.L.6. aet. XII	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
23	...	R.L.6. aet. VIII	1	....	B.N. 1	11 $\frac{1}{2}$	11 $\frac{1}{2}$	13
24	P.	Impacted L.L.8	3injections 1 ccm. each	....	B.N. 2	5	11 $\frac{1}{2}$	113
25	P.	Abscesed R.L.7	1	....	B.N. 1	2	11 $\frac{1}{2}$	43

* Abbreviation Br. = Bromural.

LOWER JAW IN ORAL SURGERY

Time of Waiting	Sedatives given	Other Medication	RESULT	REMARKS
20	Bromural gr. X	.....	Perfect Anæsthesia after 2 injections	Difficult impaction, had to use chisel and bur, operation lasted 1 hour
20	Bromural gr. X	.....	Patient complained of of a little pain	Difficult case, used chisels and burs, operation lasted 45 minutes; pa- tient marked neurotic
20	.....	.....	Perfect Anæsthesia	
20	Br.* gr. X	.....	" "	
20	Br. gr. X	.....	1st Mandibular failed; 2d, perfect	
15	Br. gr. X	Black Coffee		
30	.....	.....	.....	Child cried, stated how- ever "had no pain"
25	.....	.....	Perfect Anæsthesia	
20	.....	.....	Perfect Anæsthesia	
25	.....	.....	Perfect Anæsthesia	
20	.....	.....	Perfect Anæsthesia	
20	Br. gr. X	.....	Perfect Anæsthesia	
35	.....	.....	Perfect Anæsthesia	
20	.....	.....	Perfect Anæsthesia	
20	.....	.....	Perfect Anæsthesia	
25	.....	.....	Perfect Anæsthesia	1st Mandibular failed
25	.....	.....	Showed symptoms of Anæsthesia	Child cried
20	.....	.....	Showed symptoms of Anæsthesia	Child cried
20	.....	.....	Perfect Anæsthesia	
25	.....	.....	Showed signs of Anæsthesia	Child cried
20	.....	.....	Perfect Anæsthesia	
20	.....	.....	Showed signs of Anæsthesia	Child cried
20	.....	.....	.....	Patient said he felt a little pain, but not enough to mind it
30	Br. gr. X	.....	.....	1st and 2d Mandibular affected the lingual nerve alone, 3d in- jection gave a fairly good Anæsthesia
20	Br. gr. X	.....	Perfect Anæsthesia	

CONDUCTIVE ANÆSTHESIA IN

Case Number	Private or Hospital	OPERATION Extraction unless otherwise stated	Inferior Dental Foramen	Mental Foramen	Infiltration	Total am't of Sol. injected in ccm.	Per cent. Novocain	Total amount of Novocain used in gr.
26	...	L.L.6. aet. IX	1	.....	B. N. 1	1½	1½	1½
27	...	L.L.6. aet. VIII	1	.....	B. N. 1	1½	1½	1½
28	...	L.L.6. aet. XII	1	.....	B. N. 1	1½	1½	1½
29	...	L.L.6. aet. XIII	1	.....	B. N. 1	1½	1½	1½
30	...	L.L.6.	1	.....	B. N. 1	2	1½	1½
31	...	R.L.6. aet. XIII	1	.....	B. N. 1	1½	1½	1½
32	...	L.L.6. aet. XII	1	.....	B. N. 1	1½	1½	1½
33	...	R.L.6. aet. XII	1	.....	B. N. 1	1½	1½	1½
34	...	R.L.6. aet. XI	1	.....	B. N. 1	1½	1½	1½
35	P.	R.L.7.6.5.	1	.....	1	2	1½	1½
36	P.	L.L.8.	using* 2 ccm	.....	.....	2	2	2
37	P.	L.L.6.	2	.....	.....	2	2	2
38	...	R.L.8.7.	1	.....	B. N. 1	2	2	2
39	P.	R.L.6.	2	.....	B. N. 1	3	2	1
40	P.	R.L.6.	2	.....	B. N. 1	3	2	1
41	P.	L.L.4.		1	Ling' 1 *½†	1½	2	1½
42	P.	L.L.8.	2	.....	B. N. 1	3	2	1
43		R.L.7.	2	.....	.....	2	2	2
44	P.	R.L.8765. L.L.6.	4	1 on R.	.....	5	2	1½
45	P.	Unerrupted L.L.8.	2 ccm. on each side	.....	B. N. 1	3	2	1
46	...	Impacted R.L.8.	5 separate injections 7	.....	B. N. 2	9	2	3
47	...	chronic alveolar abscess with mental fistula	.....	1 on each side 2	.....	...	...	2
48	...	R.L.6. Pulp extirpation	2	.....	B. N.	3	2	1
49	...	R.L.8.	2	.....	.....	2	2	2
50	...	R.L.6. aet. XII	1	.....	.....	1	2	1½

*Author employed a syringe holding 2 ccm. after this; also 2% Solution of Novocain.

MANDIBLE IN ORAL SURGERY

Time of Waiting	Sedatives given	Other Medication	RESULT	REMARKS
20	.....	..	Perfect Anæsthesia	
20	.....	..	" "	
20	.....	..	" "	Shown Symptoms of Anæsthesia—child cried.
20	.....	..	" "	
20	.....	..	" "	
20	.....	..	" "	Shown Symptoms of Anæsthesia—child cried.
20	.....	..	" "	
20	.....	..	" "	Said: "Had a little pain."
25	.....	..	" "	
20	Bro. gr. X ..	..	" "	
20	Bro. gr. X ..	..	" "	
20	Bro. gr. X ..	..	" "	
20	Bro. gr. X ..	..	" "	
20	Bro. gr. X ..	..	" "	
15	.....	..	" "	
20	Bro. gr. X ..	..	" "	
20	.....	..	" "	
20	Bro. gr. X ..	..	" "	
20	Bro. gr. X ..	..	" "	
20	Bro. gr. X ..	..	" "	Got no anæsthesia of Inferior Dental Nerve. Prof. Fischer later obtained perfect Anæsthesia after second attempt. Found anatomical abnormality of mandible.
15	.....	..	" "	Opened chin on outside and curetted sinus leading into mouth. Operation lasted $\frac{1}{2}$ hr.
20	Bro. gr. X ..	..	" "	Patient referred by her dentist to have pulp removed
20	.....	..	" "	—had Arsenic in tooth 48 hours. — Pericementitis —
20	.....	..	" "	pulpitis.

Infiltration on Lingual Aspect.

CONDUCTIVE ANÆSTHESIA IN

Case Number	Private or Hospital	OPERATION Extraction unless otherwise stated	SITE OF INJECTION			Total am't of Sol. injected in ccm.	Per cent. Novocain	Total amount of Novocain used in gr.
			Inferior Dental Foramen	Mental Foramen	Infiltration			
51	P.	Fractured R.L.5	2	.....	B.N.1	3	2	1
52	P.	R.L.7.6	2 inj't's, 4	.....	B.N.1	5	2	1 $\frac{3}{4}$
53	..	L.L.8	2	.....	.....	2	2	$\frac{2}{3}$
54	..	Tumor of gum extend- ing from L.L.1-3	.....	1 ccm. ea. side	$\frac{1}{2}$ ccm. arou'd tumor	2 $\frac{1}{2}$	2	$\frac{5}{8}$
55	..	Fractured L.L.6	2	.....	.....	2	2	$\frac{2}{3}$
56	P.	Unrupted Impacted L.L.8	2	.....	B.N.1	3	2	1
57	..	R.L.6	2	.....	.....	2	2	$\frac{2}{3}$
58	P.	Unrupted Impacted L.L.5	2 injections 4	1	.....	5	2	1 $\frac{3}{4}$
59	..	L.L.6	2	.....	B.N.1	3	2	1
60	P.	L.L.8	2	.....	B.N.1	3	2	1
61	P.	R.L.6. aet. VIII	2	.....	.....	2	*1 $\frac{1}{2}$	$\frac{4}{3}$
62	..	R.L.6. aet. VIII	1 $\frac{1}{2}$	.....	.....	1 $\frac{1}{2}$	1 $\frac{1}{2}$	$\frac{1}{2}$
63	P.	Fractured L.L.7	2	.....	B.N.1	3	1 $\frac{1}{2}$	$\frac{2}{3}$
64	..	Abscessed R.L.7	2	.....	.....	2	1 $\frac{1}{2}$	$\frac{4}{3}$
65	P.	R.L.8	1 $\frac{1}{2}$	.....	.....	1 $\frac{1}{2}$	1 $\frac{1}{2}$	$\frac{4}{3}$
66	..	R.L.6. aet. XIII	2	.....	.....	2	1 $\frac{1}{2}$	$\frac{4}{3}$
67	..	R.L.8	2	.....	.....	2	1 $\frac{1}{2}$	$\frac{4}{3}$
68	..	R.L.6. aet. XIII	2	.....	.....	2	1 $\frac{1}{2}$	$\frac{4}{3}$
69	..	R.L.8	1 $\frac{1}{2}$	.....	.....	1 $\frac{1}{2}$	1 $\frac{1}{2}$	$\frac{4}{3}$
70	..	Impacted R.L.8	2	.....	.....	2	1 $\frac{1}{2}$	$\frac{4}{3}$

* After this the author returned to the use of 1 $\frac{1}{2}$ % Solution of Novocain

CONDUCTIVE ANÆSTHESIA IN

Case No.	Private or Hospital	OPERATION Extraction unless otherwise stated	SITE OF INJECTION					Total Amount of Solution Injected in Ccm.	g Novocain	Total Amount of Novo- cain Used in Grains	Time of Waiting
			Tuberosity	Posterior Palatine Canal	Anterior Palatine Canal	Infraorbital Foramen	Infiltration				
71	P.	Cyst extending L.U.1-6	1	1	1	1	Nasal t.* 1	5	1½	1½	15
72	P.	Cyst. L.U.3-4	..	..	2	1	Nasal t. 2	5	1½	1½	15
73	P.	Cyst. L.U.3	..	..	1	1	Nasal t.	2	1½	1½	15
74	...	L.U.6	1	1	..	..	½	2½	1½	1½	15
75	...	L.U.6	1	1	..	..	½	2½	1½	1½	15
76	P.	Unrupted R.U.3	..	..	1	1	..	2	1½	1½	15
77	P.	L.U.8	1	1	..	..	½	2½	1½	1½	15
78	...	L.U.5.8	1	1	..	..	1	3	1½	1½	15
79	...	R.U.6	1	1	..	..	..	2	1½	1½	10
80	...	Tumor R.U.3 region	..	..	1	1	½	2½	1½	1½	10
81	P.	Alveolotomy	..	..	1	1	Nasal t. ½	2½	1½	1½	15
82	P.	Fractured R.U.8	1	1	..	..	½	2½	1½	1½	15
83	P.	Impacted R.U.8	1	1	..	..	½	2½	1½	1½	15
84	P.	R.U.8	1	1	..	..	..	2	2	2	15
85	P.	R.U.8	1	1	..	..	..	2	2	2	15
86	P.	L.U.8	1	1	..	..	..	2	2	2	15
87	P.	L.U.8	1	1	..	..	½	2½	2	2	15
88	P.	R.U.8	1	1	..	..	..	2	2	2	15
89	P.	{ Root Amputation L.U.1	..	..	1	1	Nasal t.	2	2	2	15
90	...	Fractured R.U.8	1	1	..	..	..	2	2	2	15
91	...	L.U.4.6.8	1	1	..	1	..	3	2	1	10
92	...	Malposed R.U.3	..	..	1	1	..	2	2	2	10
93	...	{ Necrosis extending L.U.3-5	..	..	1	1	½	2½	2	2	15
94	P.	Fractured R.U.8	1	1	..	..	..	2	2	2	10
95	P.	R.U.8	1	1	..	..	..	2	2	2	10
96	P.	Abscessed L.U.6	1	1	..	..	..	2	2	2	15
97	P.	Root amputation R.U.2	..	..	1	1	Nasal t. 1	3	2	1	15

* Tampons of Novocain solution in nose; also 1 ccm. by infiltration.

UPPER JAW IN ORAL SURGERY

Sedatives Given	Other Medication	RESULT	REMARKS
†Br. gr. X		Perfect Anæsthesia	Operation lasted 1 hour
Br. gr. X	Aromatic Ammonia	" "	Operation lasted 1 hr.
Br. gr. X		" "	Patient in ill health for some time, fainted after operation—revived promptly
.....		" "	Operation lasted 30 min.
.....		" "	
Br. gr. X		" "	
Br. gr. X		" "	
Br. gr. X		" "	
Br. gr. X		" "	
Br. gr. X		" "	
Br. gr. X		" "	
Br. gr. X		" "	
Br. gr. X		" "	
.....		" "	
.....		" "	
.....		" "	
.....		" "	
Br. gr. X		" "	
Br. gr. X		" "	
Br. gr. X		" "	
Br. gr. X		" "	

† Bromural.

CONDUCTIVE ANÆSTHESIA IN

		OPERATION Extraction unless otherwise stated	Tuberosity	Posterior Pal. Canal	Anterior Pal. Canal	Infraorbital Foramen	Infiltration	Total am't of Sol. injected	Per cent. Novocain	Total amount of Novocain used
98	P.	R.U.8.	1	1	...	...	...	2	2	...
99	P.	Unerrupted L.U.3.	...	...	1	1	Nasal t.	2	2	...
100	P.	R.U.7.3.	1	1	...	1	...	2	2	1
101	P.	L.U.7.	1	1	...	...	...	2	2	...
102	P.	Abscessed L.U.7.	1	1	...	...	...	2	2	...

CONDUCTIVE ANÆSTHESIA IN BOTH UPPER

		OPERATION Extraction unless otherwise stated.	SITE OF INJECTION IN UPPER JAW.						SITE OF	
			Tuberosity	Posterior Pal. Canal	Anterior Pal. Canal	Infraorbital Foramen	Infiltration	Nasal Tampons	Inferior Dental Foramen	
103	P.	{ R.U.8. L.U.8. R.L.8.	1.E.S. 2	1.E.S. 2	..	.....	..	..	1	
104	P.	{ R.U.8.7.6.5.3.2.1. R.L.8.7. 3.2.1, L.L.1.2.3.4.5.6.7.8. L.U. 6.7. }	1.E.S. 2	1.E.S. 2	1	1.E.S. 2	..	..	1.E.S. 2	
105	P.	{ R.U.8. L.U.8. R.L.8.	1.E.S. 2	1.E.S. 2	..	.....	..	..	1	
106	P.	R.U.7. L.U.7 R.L.321. L.L.1.23.	1.E.S. 2	1.E.S. 2	..	.....	..	..		
107	P.	R.U.8 L.L.5 7	1	1	..	.....	..	..	2	
108	P.	{ R.U.6.3.2.1. L.U.3. L.L.6.7.	1	1	..	1	..	..	2	
109	P.	L.U.6.8. L.L.5.7.8.	1	1	..	.....	..	..	2	
110	P.	{ R.U.8.4. L.U.4.5. } { R.L.7.5. L.L.5.6.7. }	1	1	1	1.E.S. 2	1	..	2	
111	P.	R.U.6. R.L.6.	1	1	..	.....	..	..	2	

UPPER JAW IN ORAL SURGERY

Time Waiting	Sedatives	Other Medication	RESULT	REMARKS
15	Bro. gr. X	.....	Perfect Anæsthesia	
10	Bro. gr. X	.....	" "	
10	Bro. gr. X	.....	" "	
15	Bro. gr. X	.....	" "	
15	Bro. gr. X	.....	" "	

AND LOWER JAWS IN ORAL SURGERY

INJECT. L. JAW						Sedatives	RESULT	REMARKS
Mental Foramen	Infiltration	Total Amount of Sol. Injected	Per cent. Novocain	Total Amount of Novocain used	Time of Waiting			
.....	B.N. 1	6	1½	1½	20	Bro. gr. X	Perfect Anæsthesia	
1	B.N. 1	11	1½	2½	20	"	" "	Absolutely no reaction!
.....								
.....	B.N. 1	6	2	2	20	"	" "	
.....								
1.E.S. 2	.....	6	2	2	20	"	" "	
.....	B.N. 1	5	2	1½	20	"	" "	
.....	.....	5	2	1½	20	"	" "	
½	½	5	2	1½	20	"	" "	
.....	.....	8	2	2½	20	"	" "	
.....								
.....	.....	4	2	1½	20	"	" "	

CONDUCTIVE ANÆSTHESIA IN

Case No.	OPERATION	Inferior Dental Foramen	Infiltration	Per cent. Novocain	Amount of Solution in ccm.
112	Ground down Left L. 4 and 7, for bridge abutments	2	...	1½	2
113	Pulp removed Left Lower 6 y. molar	1½	...	1½	1½
114	Cavity preparation L.L.4.5.7.....	2	...	1½	2
115	Cervical cavity preparation R.L.7.6.....	2	...	1½	2
116	Cavity preparation L.L.6.7.8	2	...	1½	2
117	Cavity preparation L.L.6 7	2	...	1½	2
118	Cavity preparation R.L.7.6	2	...	1½	2
119	Prepared cavity in L.L.7. Extracted L.L.6.....	2	...	1½	2
120	Removed pulp R L.6.....	2	..	1½	2
121	Cavity preparation L.L.4.....	2	...	1½	2
122	Cavity preparation L L.7	1½	...	1½	1½
123	Cavity preparation L.L.6. Removed pulp L.L.4	2	...	1½	2
124	Prepared L.L.4.7 for bridge abutments.....	2	...	1½	2
125	Cavity preparation, R.L.7 (very sensitive) ..	2	1	1½	3
126	Prepared compound cavity, R.L.7.	1	1	1½	2
127	Prepared very sensitive erosion cavity, L.L.7....	2	...	1½	2
128	Removal of pulp, L.L.7	2	...	1½	2
129	Removal of pulp, R.L.6.....	2	...	1½	2
130	Cavity preparation, L.L.7.....	2	...	1½	2
131	Cavity preparation, R.L.6.7	2	...	1½	2

* Records furnished by S. W. A. Frankan, D.D.S., and H. F. Barge, D.D.S.

MANDIBLE IN OPERATIVE DENTISTRY*

Amt. of Novo- cain used in gr.	Time of Waiting	RESULT	REMARKS
15	15	Perfect Anæsthesia	
8	8	" "	
12	12	" "	
5	5	" "	
10	10	" "	
9	9	" "	
10	10	" "	
5	5	" "	Child aet. XI, very nervous, complained of slight pain
15	15	" "	
12	12	" "	
8	8	" "	
10	10	" "	
8	8	" "	Pallor and tremor, passed off
10	10	" "	After 12 minutes began to excavate cavity, not sensitive any more, took wax pattern for inlay
10	10	" "	
12	12	" "	Patient called up later in day and complained of pain in temple
5	5	" "	Began to work after 5 minutes, entered pulp chamber after 15 minutes; patient complained of slight pain; waited a few minutes, placed a drop of novocain in cavity and removed a very much constricted pulp
20	20	" "	Removed pulp, found two large pulp nodules; pressure anæsthesia had failed previously
20	20	" "	No sensation after 18 min., prepared large M.O.D. cavity
10	10	" "	Prepared 2 compound cavities, took 1 hour

CONDUCTIVE ANÆSTHESIA IN

Case Number	OPERATION	Tuberosity	P. P. C.	A. P. C.	Infraorbital Foramen	Infiltration	% Novocain
132	Cavity preparation R.U.7.6	1½	.....	.....	.....	.....	1½
133	Pulp removal L.U.3	.....	.....	.....	2 inj. 1½ Ea.	.....	1½
134	Cavity preparation L.U.6	1½	.....	.....	.....	.....	1½
135	Pulp removal L.U.6	1½	½	.....	.....	.....	1½
136	Preparation of root for Logan Crown L.U.1.	.....	½	1½	A few drops	.....	1½
137	Preparation of bridge abut- ments R.U.7.3	1½	.....	1	.....	.....	1½
138	Cavity preparation L.U.6.8	1½	.....	.....	.....	.....	1½
139	Preparation for crown L.U.6	1½	.....	.....	.....	.....	1½
140	Cavity preparation R.U.7.6	2	.....	.....	.....	.....	1½
141	{ Cavity preparation R. U.7.6 }	1½ R.	.....	.....	.....	.....	1½
	{ Pulp removal L.U.7 at one session }	1½ L.	.....	.....	.....	.....	
142	{ Pulp removal R.U.6. Cavity prep. L.U.6.7 }	1½ E.S.	.....	.....	.....	.....	1½
143	Cavity prep. L.U.1.2. Pulp removal L.V.3	.....	.....	1½	.....	.....	1½
144	Cavity preparation L.U.8	1½	.....	.....	.....	.....	1½
145	Cavity preparation L.U.6	1½	½	.....	.....	.....	1½
146	Cavity preparation L.U.1	.....	.....	1½	.....	.....	1½
147	Pulp removal R.U.1	.....	.....	1½	.....	.....	1½
148	Cavity preparation R.U.7	1½	.....	.....	.....	.....	1½
149	Pulp removal R.U.1*	.....	.....	.....	.....	1½	1½
150	Pulp removal R.U.5*	.....	.....	.....	.....	2	1½

* Are Infiltration Anæsthesias.

UPPER JAW IN OPERATIVE DENTISTRY

Total Amount of Sol.	Total Amount of Novocain in gr.	Time of Waiting	RESULT	After Effects	REMARKS
1½	1 8	6	Perfect Anæsthesia	None	
3	2 8	10	" "	"	
1½	1 8	7	" "	"	
2	2 8	5	Good	"	Patient complained of a very slight pain
2X	2 8	8	Perfect Anæsthesia	"	Infiltrated gum about Central with a few drops
2½	...	10	" "	"	
1½	1 8	8	Good	"	Patient complained of a little pain
1½	1 8	7	Perfect Anæsthesia	"	
2	4 8	6	" "	"	
3	2 8	8	.....	.....	{ R.U.6. Slight Sensation. L U.6.7. Perfect Anæsthesia
3	2 8	5	Perfect Anæsthesia	"	{ Slight cyanosis, disappeared shortly.
1½	1 8	5	" "	"	
1½	1 8	8	" "	"	
2	2 8	8	" "	"	
1½	1 8	7	" "	"	
1½	1 8	10	" "	"	
2	4 8	5	" "	"	
1½	1 8	5	" "	"	{ Injected ½ ccm. between neck and apex facially Injected 1 ccm. between neck and apex on palatine aspect Injected 1 ccm. on Lingual surface Injected 1 ccm. on Buccal aspect
2	4 8	8	" "	"	

Reviewing the preceding tables, we have a total of one hundred and fifty conductive anæsthesias, of which seventy are in the lower jaw, for oral surgical cases, with fifty-nine perfect anæsthesias; of these fifty-nine, three had to be injected twice. Case No. 2 complained of a little pain. Cases Nos. 7, 17, 18, 20, 22, 28, 33 were children, who were all more or less frightened. It is difficult to say whether these children cried from fright or pain, particularly as some of these cases did not wince when the gum and lips were pricked with a pin. The writer once gave a mandibular injection to a child three years old for the removal of an abscessed molar; the youngster cried very bitterly, but stated that he felt no pain, but was frightened.

Case No. 46 was injected five times, and no anæsthesia of the mandibular nerve was obtained. Failure in this case was due to anatomical anomaly of the mandible.

Cases Nos. 2-24 gave evidence of only part-anæsthesia.

The thirty-two conductive anæsthesias in the upper jaw in oral surgical cases were all perfect.

The nine conductive anæsthesias in both upper and lower jaws were all perfect.

The forty anæsthesias in operative dentistry cases were all (excepting Cases Nos. 119, 135, 138) perfect.

Summing up the experience of more than a

thousand conductive anæsthesias, the writer would say that failure to obtain perfect results is due to:

1. Faulty technique, i.e., not injecting at the proper place.
2. Personal equation of the patient (idiosyncrasy).
3. Not waiting sufficiently long.

Unpleasant After-Effects

1. Pain due to $\left\{ \begin{array}{l} \text{faulty asepsis,} \\ \text{the use of hetero-tonic solu-} \\ \text{tions.} \end{array} \right.$
2. Swelling due to $\left\{ \begin{array}{l} \text{faulty asepsis,} \\ \text{muscle infiltration.} \end{array} \right.$
3. Locked jaw due to $\left\{ \begin{array}{l} \text{muscle infiltration,} \\ \text{infection (faulty asepsis).} \end{array} \right.$
4. Palpitation, blanching, due to overdose of adrenalin.

Sometimes a mandibular injection will give the symptoms of a perfect anæsthesia, but when certain parts of the tooth are reached, the dento-enamel line or the pulp, sensation is still found. This, the writer believes, is due to the fact that the anæsthetic has not been absorbed by the nerve through its entire thickness, and that those fibres reaching the sensitive part have not become infiltrated by the anæsthetic.

The basal requisites for successful local anæsthesia in all its forms are:

1. Absolute asepsis.
2. The use of isotonic solutions.
3. Knowledge of anatomical landmarks.
4. Judgment of patient's physical state.
5. The use of pure, non-oxidized drugs; a discolored tablet or solution should not be used.

Any ill effects following the use of novocain-suprarenin, as blanching, cyanosis, perspiration, dyspnœa or palpitation, are counteracted by the inhalation of amyl-nitrite or vaporole or the administration of coffee. The writer never had occasion to employ more heroic treatment.

KEY TO CONDUCTIVE ANÆSTHESIA FOR EXTRACTIONS

Upper Jaw

3d Molar, Tuberosity, 1 ccm.; P.P.C., 1 ccm.
Wait 5-10 minutes.

2d Molar, Tuberosity, 1 ccm.; P.P.C., 1 ccm.
Wait 5-10 minutes.

1st Molar, Tuberosity, 1 ccm.; P.P.C., 1 ccm.
Wait 5-10 minutes.

2d Bicuspid, Tuberosity, 1 ccm.; P.P.C., 1 ccm.
Wait 5-10 minutes.

1st Bicuspid, Infraorbi. for., 1 ccm.; A.P.C., $\frac{1}{2}$ ccm. Wait 5-10 minutes.

Canine, Infraorbi. for., 1 ccm.; A. P. C., $\frac{1}{2}$ ccm.
Wait 5-10 minutes.

Lateral, Infraorbi. for., 1 ccm.; A.P.C., $\frac{1}{2}$ ccm.
Wait 5-10 minutes.

Central, Infraorbi. for., 1 ccm.; A.P.C., $\frac{1}{2}$ ccm.
Wait 5-10 minutes.

Lower Jaw

3d Molar, Mandibular, 2 ccm. Wait 10-20 minutes.

2d Molar, Mandibular, 2 ccm. Wait 10-20 minutes.

1st Molar, Mandibular, 2 ccm. Wait 10-20 minutes.

2d Bicuspid, Mandibular, or Mental for., 1 ccm.;
and Lingual Aspect of Bic., $\frac{1}{2}$ ccm.

1st Bicuspid, Mandibular, or Mental for., 1 ccm.;
and Lingual Aspect of Bic., $\frac{1}{2}$ ccm.

Canine, Mental for., 1 ccm.; Mental fossa of opposite side, $\frac{1}{2}$ ccm.

Lateral, Mental for., 1 ccm.; Mental fossa of opposite side, $\frac{1}{2}$ ccm.

Central, Mental for., 1 ccm.; Mental fossa of opposite side, $\frac{1}{2}$ ccm.

Also Lingual Aspect of Canine, $\frac{1}{2}$ ccm.; of Lateral, $\frac{1}{2}$ ccm.; of Central, $\frac{1}{2}$ ccm.

Waiting for Lower 2d Bicuspid, Central, 5-10 minutes.

A Mandibular injection can be done for all lower teeth; waiting time is then 10-20 minutes.

KEY TO CONDUCTIVE ANÆSTHESIA FOR MULTIPLE
EXTRACTIONS

To Anaesthetize One-Half Upper Jaw

Tuberosity, 1 ccm.

P.P.C., 1 ccm.

A.P.C., $\frac{1}{2}$ ccm.

Infraorb. for., 1 ccm.

To Anaesthetize the Upper Jaw Completely

Tuberosity, 1 ccm., on both sides.

P.P.C., 1 ccm., on both sides.

A.P.C., 1 ccm., on both sides.

Infraorb. for., 1 ccm., on both sides.

*To Anaesthetize the Whole Left Side, and the
Right Up to and Including the Canine*

Mandibular, 2 ccm (left).

Mental for., 1 ccm., on other side (right).

Lingual Aspect of right side in anterior portion, 1 ccm.

To Anaesthetize Six Anterior Teeth in Mandible

Mental for., 1 ccm., on both sides.

Lingual Aspect, $\frac{1}{2}$ ccm.

*To Anaesthetize the Six Anterior Teeth, Upper
Jaw*

Infraorbital for., 1 ccm, on both sides.

A.P.C., 1 ccm.

To Anaesthetize Four Lower Centrals

Mental fossa, on both sides, 1 ccm.

Incisal foramina, $\frac{1}{2}$ ccm.

KEY TO INFILTRATION ANÆSTHESIA FOR EXTRACTIONS

Upper Jaw

3d Molar, inject facially about center of root, $1\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

2d Molar, inject facially about center of root, $1\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

1st Molar, inject facially about center of root, $1\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

2d Bicuspid, inject facially about center of root, 1 ccm.; lingually, $\frac{1}{2}$ ccm.

1st Bicuspid, inject facially about center of root, 1 ccm.; lingually, $\frac{1}{2}$ ccm.

Canine, inject facially about center of root, 1 ccm.; lingually, $\frac{1}{2}$ ccm.

Lateral, inject facially about center of root, $\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

Central, inject facially about center of root, $\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

Lower Jaw

3d Molar, inject facially about center of root, $1\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

2d Molar, inject facially about center of root, $1\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

1st Molar, inject facially about center of root, $1\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

2d Bicuspid, inject facially about center of root, 1 ccm.; lingually, $\frac{1}{2}$ ccm.

1st Bicuspid, inject facially about center of root, 1 ccm.; lingually, $\frac{1}{2}$ ccm.

Canine, inject facially about center of root, 1 ccm.; lingually, $\frac{1}{2}$ ccm.

Lateral, inject facially about center of root, $\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

Central, inject facially about center of root, $\frac{1}{2}$ ccm.; lingually, $\frac{1}{2}$ ccm.

KEY TO LOCAL ANÆSTHESIA IN OPERATIVE DENTISTRY. FOR OPERATIONS UPON:

Upper Molars—Tuberosity— $1\frac{1}{2}$ ccm. wait 5-10 minutes.

Upper Bicuspids—Infiltrate both Facial and Lingual aspect of process near apex— $\frac{1}{2}$ -1 ccm. wait 5-10 minutes.

Upper Canine—Infraorbital foramen 1 ccm. wait 5-10 minutes.

Upper Lateral	}	as Canine or Infiltrate as Bicuspids or insert tampons dipped in 20% Novocain sol. into narce.
Upper Central		

Lower Molars—Mandibular injection 2 ccm. wait 10-20 minutes.

Lower Bicuspids	} Mental foramen 1 ccm. wait 5-10 minutes.	} or mandibular injection 2 ccm. (and mental foramen or mental fossa on opposite side for central region).
Lower Canine		
Lower Lateral	} Infiltrate mental fossa 1 ccm. wait 5-10 minutes.	
Lower Central		

The injection of the incisal fossae on both sides as well as lingual infiltration will anæsthetize the four incisors.

The author has attempted to present the subject of Local Anæsthesia, as of interest to the Dental and Oral Specialist in as concise and practical form as possible.

This book should not be looked upon as a Text-book, but as a guide to the student and practitioner. In conclusion the writer desires to reiterate that Local Anæsthesia in its various forms is the staunchest ally of the Oral specialist in combating pain, but that in its thoughtless and incorrect use *lurks danger*.

It is *not* a method to be employed for scaling teeth or to gratify the whim of a patient, but it is a means of reducing pain.

All types of Anaesthesia must be administered with caution, whether Local or General.

It is foolhardy to use without proper instruction.

It is dangerous in the hands of the man who does not appreciate the full meaning of Asepsis.

XII

USEFUL FORMULÆ AND PRESCRIPTIONS

1. *Formulae*

Thiersch's Solution

Used as a wet dressing in inflammation and swelling of soft parts; also for irrigation of suppurating wounds.

Acidi Salicylici	2.0	5	ss
Acidi Borici	12.0	5	iii
Aquæ dest.	1000.0	3	

S. For external use.

Ringer's Solution

Used as a solvent medium for local anæsthetics.

Natrii. chloridi	0.5
Calcii chloridi	0.004
Kalii. chloridi	0.02
Aquæ dest.	100.0

Normal Salt Solution

A 0.6-0.9 % solution of sodium chlorid in sterile water, solvent agent for local anæsthetics—medium for intravenous or hypodermic injections. Irrigating maxillary sinus.

Permanganate of Potash Solution

Kalii hypermangan..... 1.0

Aquæ dest.....100.0

Fifteen to twenty drops in one-half glass of water, a good deodorant wash. If used any length of time, teeth and tongue discolor. Can be used for irrigating suppurating wounds, cyst cavities, necrotic areas, maxillary sinus. Not to be used stronger.

Liquor Alumini Acetatis

Alumini sulphatis 300.0

Acidi acetici aa 300.0

Calcii carbonici 130.0

Aquæ dest.....1000.0

Diluted with four or ten parts of water, well cooled, very useful as an external application in swelling.

Diluted with nine or ten parts of water, a good astringent mouth wash. Not to be used for any length of time as a wash, as the teeth become discolored; the discoloration, however, is easily removed with pumice.

Liquor Burowi acts like the above; it is not official in this country.

R

2. Prescriptions

Liq. Alumini Acetatis, U.S.P., 120.0 (§ iv)

S. Dilute with four parts of water and apply ex-

ternally for one hour, three times a day. Label for external use.

R *As a wash*

Liq. Alumini Acetatis, U.S.P., 120.0 (℥ iv)

S. Two teaspoonfuls in a half-glass of water as mouth wash. Label for external use.

Not to be used before meals, as it might affect the appetite.

R *Antiseptic Washes*

Sol. Kalii hypermang., 1%, 60.0 (℥ ii)

S. Fifteen drops in one-half glass of water as mouth wash.

R

Sol. Hydrogenii hyperoxyd, 3%, 120.0 (℥ iv)

S. One tablespoonful in one-half glass of water as mouth wash.

Not to be used for any length of time, as the teeth become discolored, the tongue coated, and it produces a pasty taste.

R

Liq. Antisepticus Alkal., U.S.P., 120.0 (℥ iv)

S. A tablespoonful in a glass of water as mouth wash.

If Chlorate of Potash is required, the following wash is useful:

R

Kalii chloras 4.5 ℥ iss
 Tr. Myrrhæ 30.0 ℥ i
 Aquæ dest., q.s.ad..... 90.0 ℥ iii

M. S. A teaspoonful in one-half glass of water
 as mouth wash.

R

Miller's Wash

Thymolis 0.25 gr. iiiss
 Acidi Benzoici 3.0 gr. xlv
 Tr. Eucalypti 15.0 ℥ ss
 Alcoholis absol. 100.0 ℥ iiiss
 Ol. Menthæ pip..... 1.0 m xv

S. A teaspoonful in a glass of water as mouth
 wash, after meals and before retiring.

R

Astringent Washes

Liquor Burrowi, or Liq. Alumini Acetatis,
 U.S.P., 120.0 (℥ iv)

S. One to two teaspoonfuls in one-half glass of
 water as mouth wash.

R

Spt. Menthæ pip..... 4.0 ℥ i
 Acidi Tannici 0.3-0.6 gr. v-gr. x
 Tr. Myrrhæ 15.0 ℥ ss
 Tr. Arnica, q.s.ad... 120.0 ℥ iv

M. S. A teaspoonful in one-half glass of water

as mouth wash, three times daily. Label shake well. (Not to be used directly before eating.)

R

Zinci Sulphatis...0.5-2.0 gr. vii-gr. xxx
Aque Rosæ 120.0 ʒ iv

S. (Astringent stimulating wash) Mouth wash.

For Acute Periostitis or Adentis

R

Unguenti Ichthyoli, 5-20 %....60.0 ʒ ii

S. Apply locally.

Internal Medication

Nerve Sedatives

R

Tab. Bromural (Knoll & Co.), aa 0.3 (gr. v)

D. No. x.

S. One to two tablets twenty minutes before operation.

If to be given for continued action, give one to two tablets three times daily.

Bromural is a very happy combination of Bromides and Valerian.

R

Kalii bromid. 30.0 ʒ i
Aque Cinnamoniis 120.0 ʒ iv

S. A teaspoonful in a little water.

For Post Extractive Pain

℞

Caps. Trigemini *aa*.....0.3 gr. v

D. No. vi.

S. One capsule every three hours until relieved.

℞

Phenacetine

Aspirine, *aa*.....2.0 gr. xxx

Divide in chartulas No. vi.

S. One powder every three hours until relieved.

If an opiate is required:

℞

Phenacetine 0.7 gr. xii

Natrii bicarb.....1.3 gr. xx

Codeine Sulph.....0.06 gr. i

Caffeine citrat.....0.24 gr. iv

Misce et, divide in chartulas No. iv.

S. One powder every three hours until relieved.

In extreme cases, where the patient is suffering severe pain and is very restless:

℞

Morphiæ Sulph..... 0.015 gr. $\frac{1}{4}$

Kalii Bromid..... 2.0 gr. xxx

Aquæ 30.0 $\frac{3}{4}$ i

S. One-half to be taken at once; balance in three hours, if necessary.

Non-repitantur!

Laxatives

It is always advisable to prescribe a laxative in cases of alveolar abscess.

Castor oil (*Ol. Ricini*) is one of the ideal drugs, but its unpleasant taste makes it difficult to administer. It can be given in gelatin capsules, which renders it tasteless and odorless. These capsules are made up in different sizes; for adults six 2½ gram capsules ($6 \times 37.5 = 225$ minims, about a half ounce) constitute the usual dose. These capsules are swallowed easier if they are moistened in water. They are best taken before retiring.

Cascara Sagrada can be prescribed in liquid or solid form.

Tab. Cascara Sagrada, *aa* 0.3; chocolate coated.

One to two tablets before retiring.

Or—

Ext. Cascara Sagrada fld., 10-30 minims.

R

Liq. Magnesii Citratis, U.S.P.

S. One-half to one. Twelve-ounce bottle.

For the Control of Hemorrhage

R

Vin. ergotæ (Squibb's) . . . 90.0 3 iii

S. A teaspoonful every two hours.

℞

Acidi Gallici..... 4.0 ʒ i
 Acidi Sulphurici diluti.... 8.0 ʒ ii
 Aquæ dest., q.s.ad.....90.0 ʒ iii

S. A teaspoonful every four hours.

℞

Calcii lactatis.....6.0 ʒ iss

Divide in chartulas No. vi.

S. One powder every three hours.

General Tonic

℞

Strychniæ Sulphatis
 Acidi Arsenoisi aa 0.06
 Quininæ Sulphatis 2.0
 Ferri Sulphatis Axsiccat..... 1.0

M. et. f. piluæ No. xxx.

S. One after each meal.

XIII

POISONS AND THEIR ANTIDOTES

Aconite

ANTIDOTE: Keep patient in prone position, feet higher than head. Place hot bottles about body to retain bodily heat. Ether hypodermatically; this followed by alcohol, and this by digitalis. If breathing fails, artificial respiration; if the heart fails, a few drops *only* of amyl nitrite by inhalation.

Ammonia

Milk, vinegar, dilute citric acid; small pieces of ice.

Arsenic

Stomach-pump, external heat, stimulants and chemical antidote, hydrated sesquichloride of iron and magnesia. Give morphine to allay pain; large draughts of water to flush kidneys and dilute poison.

Carbolic Acid

Large doses of whiskey; Epsom salts, warm mucilaginous drinks, hot applications to extremities, emetics; stomach-pump with great care, as the intestinal tract, mouth and pharynx is cauterized.

Cocaine

Ammonia, coffee, strychnia, ether and alcohol. If convulsive in type, treat like strychnine poisoning.

Corrosive Sublimate

Large amounts of egg albumen, followed by stomach-pump, external heat, stimulants.

Ether

Artificial respiration; strychnine hypodermatically, full dose; friction and hot applications; dash ether on chest. Laborde's method of traction of tongue.

Iodine

Large amounts of starch, hot applications, emetics or stomach-pump; hypodermic injection of alcohol, ammonia, atropine, digitalis.

Iodoform

Sodium bicarbonate to combine with iodine, alcohol, diuretics and hot blankets.

Mineral Acids

Magnesium, lime, soap, white of egg as antidotes; white of egg, external heat, oils and opium to relieve irritation.

Mercury Bichloride

See *Corrosive Sublimate*.

Morphine

Emetics or stomach-pump, tannic acid, black coffee, electricity and other measures to keep patient awake; walk him around; atropine or strychnine hypodermatically if respiration fails, artificial respiration; repeated washing of stomach. Permanganate of potash.

Novocain

Amyl nitrite inhalation, coffee (see *Cocaine*).

Nitrate of Silver

Common salt as antidote; opium and oils to allay irritation, also large amounts of milk and soap and water; maintain bodily heat.

Potassium Chlorate

Diuretics, saline infusion.

Strychnine

Inhalation of amyl nitrite, stomach pump, tannic acid, followed by physiologic antidotes, potassium bromide, gr. lx, and chloral, gr. xx. If convulsions prevent swallowing, chloroform patient carefully, and antidotes, per rectum, in starch water. Amyl nitrate hypodermatically if relaxation does not occur.

To produce emesis promptly administer apomorphine, gr. 1/10; gr. 1/5 hypodermatically.

XIV

TREATMENT OF EMERGENCIES

Fainting,

due to cardiac depression, causing cerebral anæmia. Lay patient flat, head lower than feet; loosen all tight clothing and admit fresh air. Give: Aromatic ammonia ("Vaporole," Burroughs, Wellcome & Co.) by inhalation, breaking a capsule in towel. Whiskey diluted in water. Aromatic spirits of ammonia 2.0, or xxx drops diluted in water.

Hiccoughs

Spirits of camphor one drachm. Hoffman's anodyne one drachm in water. Amyl nitrite by inhalation.

Heartfailure

Adrenalin 1:1000, one to two drachms in pint of normal saline, intravenously or by hypodermodysis.

Epistaxis

Pack nostril tightly with gauze dipped in adrenalin (adrenalin 1:1000, 1 drachm to 6 oz. of water), and press the alæ of the nose together with the fingers.

Collapse or Shock

This may be mild or severe; the mild form will show in blanching and a few gasping respiratory movements, and then color will return to the face and the patient will feel better. Laying the patient flat, and aromatic ammonia by inhalation, will usually overcome this.

The more severe form will be indicated by blanching, clammy skin, beads of perspiration on the forehead, dilated pupils, diminished reflexes, frequent irregular pulse and feeble sighing respiration. Temperature subnormal, the patient may be unconscious or retain his senses.

Treatment: Patient should be laid flat, head low, covered with blankets, dry heat to body. If he can swallow whiskey in small doses, 1 drachm, with $\frac{1}{2}$ drachm spirits of ammonia, or strychnia in gr. $\frac{1}{30}$ gr. $\frac{1}{20}$ hypodermatically, or caffeine in gr. ii doses, or ether 30 min. hypodermatically.

Hysterical Attack

Application of cold water to the face, ammonia by inhalation, or Hoffman's anodyne, 30 drops in water. If convulsions occur, ice to the back or apomorphine, gr. $\frac{1}{12}$, hypodermatically; this will cause emesis and stop the attack.

Nervous Attack

Bromides, Valerian Bromural (Knoll), gr. x.

Convulsions

Place Denhart gag between patient's jaws, so he cannot close his teeth and bite his tongue. Keep a pair of tongue forceps handy, so that the tongue can be grasped, that it cannot be swallowed. Lime chloral and bromides; if violent, a little chloroform by inhalation.

XV

GLOSSARY

Abscess, a localized collection of pus surrounded by a lymph wall.

Aconite, a genus of herbs; also the poisonous roots and leaves of *aconitum napellus*.

Acute, rapid, severe, sharp.

Adrenalin, the active principle of the suprarenal gland.

Alkaloid, an organic base of vegetable origin causing toxic effects.

Alum, sulphate of potassium and aluminum.

Alveolus, bony socket of a tooth.

Alveolar process, portions of jaw bearing the teeth.

Alveolitis, inflammation of alveolus.

Ammonia, a pungent gas, NH_3 , very soluble in water.

Analgesia, insensibility to pain.

Anaemia, a deficiency of blood or red blood corpuscles;

primary, that caused by disease of the blood or the blood-making organs;

secondary, that due to a distinct cause, or loss of blood.

- Anaesthesia*, a state of insensibility;
general, one affecting the whole body;
local, limited to a part of the body;
conductive, due to blocking off an afferent nerve;
regional, limited to a part supplied by an afferent nerve which has been anæsthetized;
infiltration, due to subcutaneous injections.
- Angina*, a sense of suffocation;
Vincent's, a diphtheroid inflammation due to a spirillum and fusiform bacillus;
Ludwig's, cellulitis of submental and sub-maxillary tissues.
- Antrum*, a cavity, especially in bone;
of Highmore, cavity in the superior maxilla.
- Anuria*, suppression of urine.
- Arsenic*, a chemic element; in small doses its combinations useful as a tonic; also used as an escharotic.
- Asepsis*, an absence of septic matter.
- Aspirin*, aceto salicylic acid; an anti-rheumatic remedy; useful to stop all types of pain.
- Asthma*, paroxysmal dyspnoea, with oppression.
- Astringent*, an agent producing contraction of organic tissue or the arrest of discharges.
- Blanching*, turning pale.
- Bromural*, proprietary combination of Bromide and Valerian.

Calomel ointment, an ointment containing calomel.

Capsula, a capsule.

Chancre, primary or hard syphilitic ulcer, the initial lesion.

Chartula, a paper containing a medicine.

Chronic, long continued, the reverse of acute.

Clot, a mass of thickened blood, coagulum.

Clotting, the thickening of drawn blood.

Coaguability, the ability to clot.

Curetage, the use of a curette (scraping).

Cyst, a membranous sac containing liquid.

Cystic, pertaining to a cyst;

degeneration, degenerating with cyst formation.

D., abbreviation for *donne* (latin), give.

Degeneration, deterioration of a structure or organ.

Diabetes, a disease of nutrition.

Disintegration, destruction.

Divide, divide.

Divide in, divide into.

Drainage, the gradual removal of contents from a suppurating cavity.

Edema, an accumulation of serum in cellular tissue.

Embolism, obstruction of a blood vessel by an embolus.

Embolus, a blood clot or other body carried by the blood.

Endocarditis, inflammation of endo-cardium, the inner lining of the heart.

Endosmosis, the passage of a liquid through a septum from without inward.

Ergot, a fungus parasitic upon rye (*Claviceps purpurea*).

Erotic, pertaining to sexual passion.

Etiology, the science of the causes of diseases.

Exosmosis, the passage of a liquid through a septum from within outward.

Fever, disturbed nutrition, associated with rise of body temperature.

Fever sore, ulcer supposedly to be caused by fever.

Gallic acid, acid obtained from nutgalls.

Gangrene, death of soft tissue.

Grain, the smallest division of a pound, $1/480$ of an ounce.

Gram, unit of weight of metric system, equals 15.43 grains, troy weight.

Hemoglobin, coloring matter of red blood corpuscles.

Hemoglobinometer, an instrument to determine the amount of hemoglobin in the blood.

Hemophilia, a disease of the blood prohibiting its normal coagulation.

Hemophiliac, one who suffers from hemophilia.

Hemorrhage, escape of blood from a vessel artery, vein or capillary;
primary, loss of blood at time of injury;
secondary, loss of blood after bleeding has once stopped.

Hypertonic, having greater tension (osmotic pressure).

Hypodermic, under the skin.

Hypotonic, having lesser tension (osmotic pressure).

Idiosyncrasy, individual peculiarity.

Implantation, the act of setting in, grafting of tissue from one person to another;
physiologic, grafting living tissue;
mechanical, grafting dead tissue.

Infection, invasion by disease germs.

Infiltration, fluid effusion into an organ or tissue.

Intravenous, into the veins.

Iodize, to apply iodine.

Iodoform, yellow antiseptic powder.

Irrigation, constant washing.

Isotonicity, state of having the same osmotic pressure as the blood serum.

Kilogram, a metric weight, 1000 grams.

Laryngology, specialty treating disease of the larynx.

Laxative, a purgative.

Lege artis, according to the law of the art (correctly).

Lethal, deadly, fatal, causing death.

Lock jaw, trismus.

Locked jaw, condition when the jaws cannot be opened or closed due to swelling of the soft parts.

Lues, syphilis.

Luetic, syphilitic.

Luxated, loosened.

Lysol, a disinfectant and antiseptic from cresol.

Mandible, the lower jaw.

Maxilla, the jaw.

Maxillary sinus, the antrum of Highmore.

Metastasis, a change of seat in a disease (a cancer of the breast may produce metastasis in the liver).

Metastatic, pertaining to metastasis.

Millimeter, the thousandth part of a meter.

Monsels' solution, Ferric subsulphate in solution, a styptic.

Myelitis, inflammation of spinal marrow.

Myocarditis, inflammation of heart muscle.

Necrosis, death of bone.

Nephritis, inflammation of the kidney.

Nerves, sensory, same as afferent, one transmitting from periphery to center;
roots, anterior, sensory roots;
posterior, motor roots.

Nervous system, nerves of body taken together; central, spinal cord and brain. •

Normal salt solution, a 0.6 to 0.9% solution of sodium chloride in water.

Novocain, a local anæsthetic, discovered by Einhorn.

Œdema, see *Edema*.

Ophthalmology, science of structure and diseases of the eye.

Ophthalmological, pertaining to the eye.

Opiates, opium preparations, hypnotics.

Organ, any part of the body with a special function.

Orgasm, the crisis of venereal passion.

Orthoform, a white crystalline powder used as an antiseptic and anæsthetic.

Pallor, paleness.

Paralysis, the loss of sensation or voluntary motion.

Periostitis, inflammation of the periosteum.

Peroxide of Hydrogen, H_2O_2 , an antiseptic.

Phenacetin, a coal-tar product, prescribed to allay pain, a cardiac depressant.

Phlebitis, inflammation of a vein.

Pneumonia, inflammation of the lungs.

Pulse, expansive impulse of arteries; thready, one scarcely perceptible.

Pus, fluid product of suppuration.

Pyemia, condition wherein pyogenic bacteria circulate in the blood.

Pyramidon, an antipyretic derivative of antepyrin.

Radiography, the art of making an X-ray picture.

Rhinology, the science of structure and diseases of the nose.

Ringer's solution, an isotonic solution containing sodium, potassium and calcium chloride.

Roentgengram, see *Skiagram*.

Sedative, producing a sedative (depressing) effect.

Septicemia, infection marked by bacteria being present in the blood.

Septic, relating to sepsis (putrefaction).

Serum, fluid constituent of the blood, separated by coagulation;

horse, from the horse, used in the treatment of hemorrhage;

human, serum from human blood.

Shock, marked lowering of vital activities due to injury or operation.

Sinus, a hollow cavity or pocket.

Sinusitis, inflammation of a sinus.

Skiagram, the finished printed X-ray picture.

Sloughing, formation of slough (death of tissue).

Spasm, a convulsive muscular contraction.

Spatium pterygo mandibulare, a flattened space between the mandible and internal pterygoid muscle, through which the mandibular and lingual nerves pass.

Sphygnomanometer, instrument to measure the blood pressure.

Sterile, barren, not fertile, free from living matter (free from bacteria).

Sterilization, method of producing sterility (destroying bacteria).

Streptococcus, a pyogenic organism, very virile.

Styptic, having the property of checking hemorrhage.

Subcutaneous, under, beneath the skin.

Suprarenin, see *Adrenalin*.

Surgery, branch of medicine dealing with operative procedure;

plastic, the repair of defective tissue by transplantation.

Symphysis, a junction of bone.

Tab., abbreviation for tablet or tablets.

Tampon, a plug of lint or cotton.

Tannic acid, from nut galls, astringent and internal hemostatic.

Thrombus, a blood clot in a vessel at the point of obstruction.

Thrombosis, the formation of a blood clot.

Tooth, one of the organs of mastication.

Toxicity, a state of being poisonous.

Transfusion, a transfer of blood into the veins; transfer of a liquid from one vessel to another.

Trauma, an injury, wound.

Traumatic shock, shock due to injury.

Traumatism, trauma.

Trigemin, an anti-neuralgic.

Trismus, a spasm of the muscles of mastication.

Urological, pertaining to Urology (science of diseases of the genito-urinary system).

Uterus, the womb.

Uterine, pertaining to the womb.

Venosity, looking like a vein, bluish.

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